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DEVOTED TO THE CONVERSION, TRANSMISSION and DISTRIBUTION OF ENERGY.

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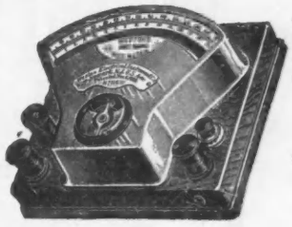

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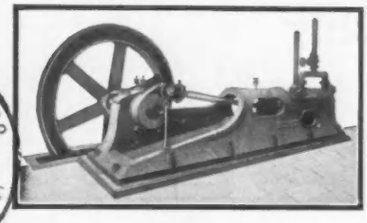

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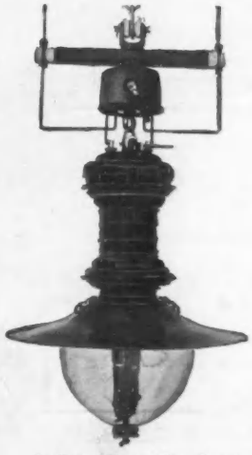

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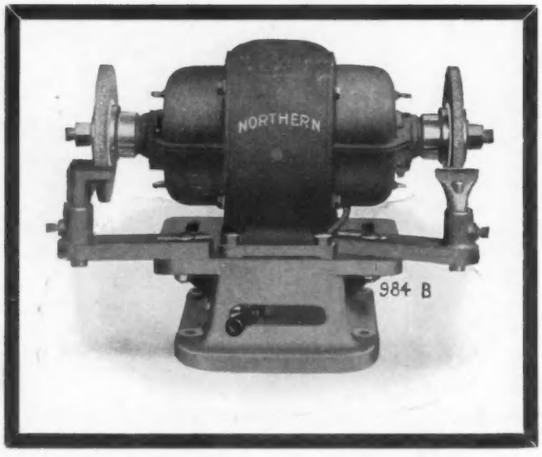

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VOLUME XV. SAN FRANCISCO, CAL., JANUARY, 1904. NUMBER 1

Alternating Current Laboratory Testing.

BY GEORGE H. ROWE.

PART I.

INSTANTANEOUS CURVES AND OSCILLOGRAMS.

THE measurement and plotting of the instantaneous values of current and electromotive force in an alternating current circuit is desirable, since by this means only is obtained an accurate picture of their instantaneous directions and magnitudes and of their relations to each other.

There are many methods of obtaining such curves. A common method depends on the use of some form of contact maker, as shown in Figures 1 and 2.

The disc D rotates in the bearing B, which is rigidly attached to the stand S. Rigid connection between the

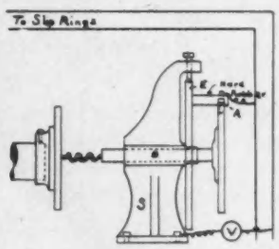


FIGURE 1

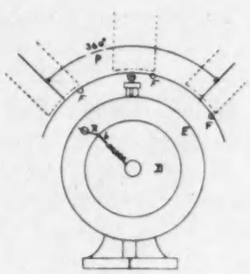


FIGURE 2

shaft of D and the shaft of the dynamo would require perfect alignment of the two shafts. It is therefore usual to make the connection by means of a spiral spring or other flexible coupling, which does not require careful setting, and insures smooth and steady running of the disc. If it is desired to use the contact maker at a distance from the alternator, the disc D may be placed on the shaft of a synchronous motor, which must, of course, be made to run from the mains to be tested.

The disc D is usually made of hard rubber, and carries a thin metal strip b in its periphery, which makes momentary contact with the brush A. The brush A is attached to the graduated circle E, which moves about a sleeve of the standard S. The strip b is electrically connected to the shaft by means of a small copper wire.

It will be seen from Figure 2 that the brush will make contact with the metal strip only when the armature conductors F bear a definite relation to the field coils. By moving the brush on the graduated circle E, a complete cycle of instantaneous values may be obtained. There will evidently be two complete cycles per revolution in a four-pole machine, or in general each cycle will be complete in $\frac{360}{p}$ degrees where p is the number of pairs of poles, except in the case of inductor alternators. In the latter the cycle is completee in $\frac{360}{p^1}$ degrees where p^1 is the number of inductor poles.

The instrument V may be an electrostatic voltmeter, or a quadrant electrometer, or other instrument capable of measuring instantaneous values. In these instruments, however, it is difficult to obtain a wide range of sensibility, and special means must be employed to obtain accurate readings throughout the wide range required. The null method described in the following article gives good results.* Contact methods are, however, commonly very slow, and cannot therefore be used in investigations where the currents and electromotive forces vary irregularly as in the alternating current arc or as in the pumping of a rotary. In such cases, some form of oscillograph must be used.

In the Blondel instrument two thin strips of soft iron are stretched vertically between the poles of a powerful permanent magnet. Very small mirrors are attached to these strips, which are also surrounded by oil, the oil serving to render the strip quick acting and "dead beat." The time of vibration of the strip and mirror combined is made very short. Twenty thousand oscillations per second is about the normal frequency. This insures accurate results when applied to the study of electrical oscillatory phenomena of frequencies up to 1000 periods per second.

About each of the small mirrors as centers are two bobbins or coils which serve to produce fields, one proportional to the variable current to be examined, the other

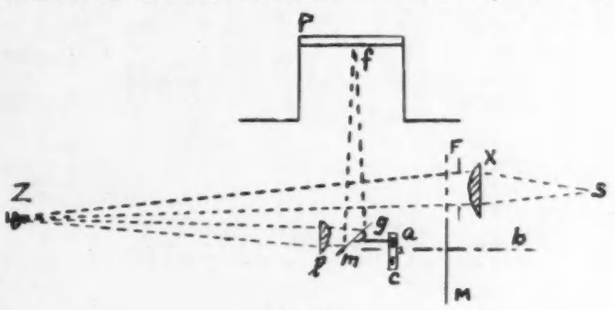


FIGURE 3

proportional to and in phase with the electromotive force. A diagram through a vertical plane of the apparatus is given in Figure 3.

*See *Physical Review*, January, 1898.

S is a source of light; X the condensing lens, focusing on the small mirror of the oscillograph Z; l a cylindrical lens; m the oscillatory mirror operated by means of a cam and synchronous motor; P the screen of ground glass on which the points of light are focused. The strip of soft iron vibrates horizontally, and the mirror m oscillating in synchronism with the generator produces the apparent motion of translation of the curves of current and electromotive force on the screen or sensitized paper.

The instrument above described is suitable for industrial work. The current coil will carry about ten amperes, and the pressure coil about one-third ampere. The small inductance of the pressure coil can be neutralized by means of a condenser, although the error from this source is small.

Another form of Blondel instrument consists of a loop of conducting material stretched in a magnetic field. On sending current through the conductor the plane of the oop will change with the current. The Duddell instrument is also a bifilar arrangement, the essentials of which are represented in Figure 4.

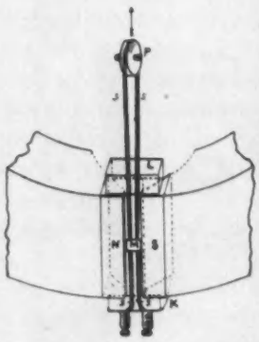
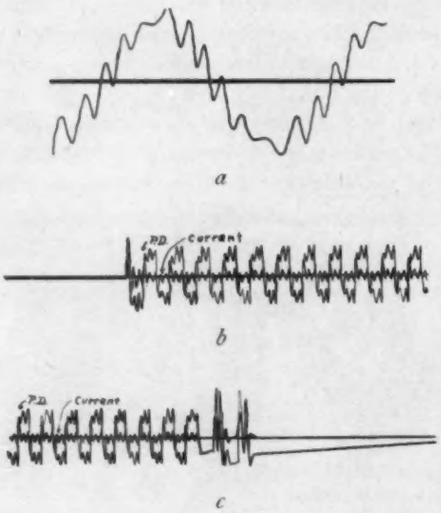


FIGURE 4

The conducting strips are of phospor bronze and are stretched upward with considerable tension by a spring attached to the pulley P. The vibration takes place between two bridges at either edge of the magnetic field and is "damped" with oil, the proper consistency of which being obtained by trial. The force due to the current must at any instant be equal and opposite to the force tending to restore the strips to the original position.



a

b

c

a—P. D. curve of alternator running on unloaded cables, eleventh harmonic prominent.

b—P. D. and current curves of alternator, showing effect of switching on high tension feeder.

c—P. D. and current curves of alternator, showing effect of switching off high tension feeder.

FIGURE 5

This result is obtained by making the natural time of vibration of the strips much shorter than that of any periodicity to be measured and by preventing free natural vibration by means of the oil damper. Light from an arc lamp is projected through condensing and cylindrical lenses to a vibrating mirror and thence to a screen or sensitized paper as in the Blondel instrument. Or, instead, the vibrating spot of light is projected directly on an Edison cinematographic film moving with uniform velocity. In this manner a continuous record extending over several seconds of time can be obtained. Two vibrating systems like that represented in Figure 4, mounted side by side in the same magnetic field, allow simultaneous oscillograms of two currents to be taken, or by the insertion of suitable non-inductive resistances, of two electromotive forces, or of a current and an electromotive force. Oscillograms obtained by means of the Duddell instrument are shown in Figure 5.

CURVES OF INSTANTANEOUS CURRENT, ELECTROMOTIVE FORCE AND POWER IN A NON-REACTIVE CIRCUIT. STEP BY STEP METHOD.

In a circuit containing resistance only, Ohm's law applies as in the direct current circuit, that is, the instantaneous current is equal to the instantaneous electromotive force divided by the resistance, or

$$i = \frac{e}{R}$$

An incancescent lamp is nearly free from magnetic and capacity reactance. This is also true of resistances in

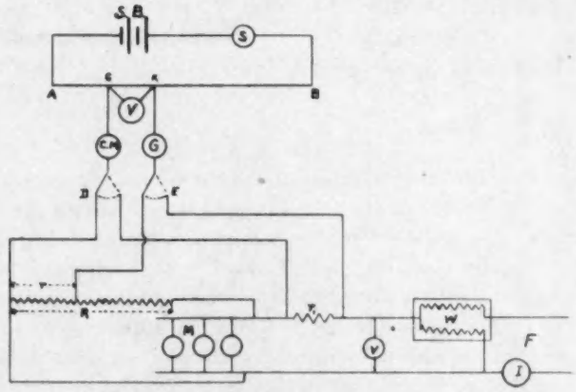


FIGURE 6

which wires or strips are wound back on themselves as in resistance boxes. Electrolytic resistance or water boxes are usually free from inductance, though they may be made to give a negative reactance.

For the investigation of a non-inductive resistance, connect as in Figure 6. Two or three storage cells send a steady current through the bridge wire AB. In order to take the electromotive force curve of the circuit F supplying the non-inductive resistance M, the switch must occupy the position D. Current is allowed to flow through the non-inductive resistance R. Care should be taken that the current is not too great, especially if the resistance R is an ordinary resistance box. In other words, the resistance R should be great enough to prevent

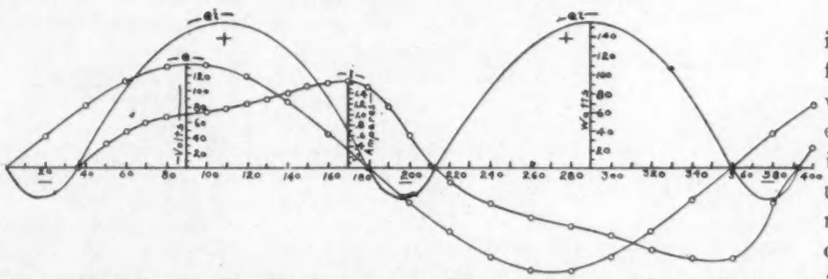
the current from doing injury to the resistance or causing a drop in the electromotive force to be measured. The electromotive force over the small resistance r is balanced at any instant against the electromotive force of the storage battery, and is measured by means of the voltmeter VM.

The galvanometer should be a quick acting, low resistance d'Arsonval. One of its terminals should be connected to the middle of the wire AB. The voltmeter reading will therefore be positive when the sliding contact C is on one side of K, and negative when on the other side. Readings should be taken for different positions of the graduated circle E, Figure 1.

The settings of the wheel E should be sufficiently close together to obtain a curve of points rather than a smooth curve drawn through a few points. The wattmeter W and the voltmeter V and the ammeter I may be placed in the circuit as shown. They will furnish a check on the results.

Similarly, a curve proportional to the current wave may be taken by throwing the switch to E. Settings on the graduated circle E should begin at the same point as in taking the curve for electromotive force. Knowing the values of R, r and r_1, the absolute values of current and electromotive may be plotted, as in Figure 7.

The ordinates of the e curve should be squared and plotted, as shown, as an e^2 curve. The area of the half wave of e^2 determined by planimeter, divided by the abscissa or length of the half wave will give the mean value of e^2. The square root of this value should be checked with the voltmeter reading v. Similarly the square root of mean square of the i curve should check with the ammeter reading I. The product of the instantaneous current and electromotive force ordinates will give a curve of watts, the mean value of which should check with the wattmeter reading.



Curves of instantaneous electromotive force, current and watts in secondary of three-kilowatt transformer, primary open. Impressed volts = 98. Potentiometer method. Wattmeter reading = 74.4. Watts from curve = 76.8. Frequency = 60~.

FIGURE 8.

CURVES OF CURRENT, ELECTROMOTIVE FORCE AND POWER IN AN INDUCTIVE CIRCUIT.

The electromotive force induced in a coil of wire is proportional to the rate of change of the magnetic flux passing through the coil and to the number of turns of the coil, or

$$e = -T\frac{d\varphi}{dt\ 10^8}$$

where e is the instantaneous electromotive force in volts, T is the number of turns and φ is the instantaneous magnetic flux passing through the coil.

When variable current is passed through any circuit, especially one containing iron, a variable magnetic flux

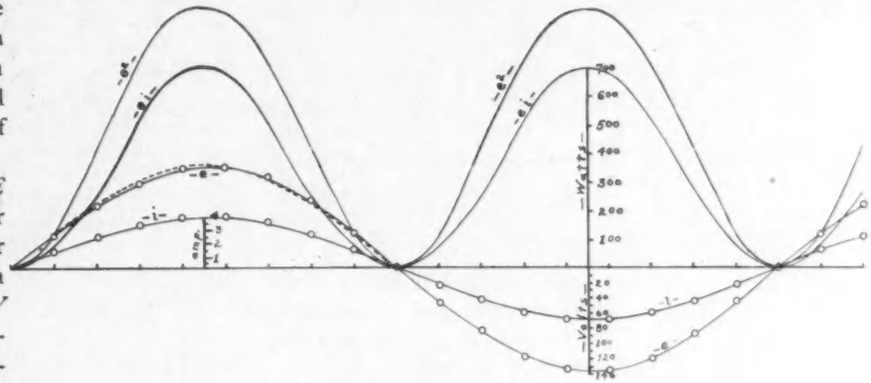


FIGURE 7

is produced, which, being linked with the turns of the circuit, causes a counter electromotive force $= e = \frac{Td\varphi}{10^8\ dt}$ as shown above. The electromotive force applied at any instant causing a current i, is such as to overcome the drop due to resistance and the counter electromotive force due to inductance, or

$$e = Ri + \frac{Td\varphi}{10^8\ dt}$$

Connect as in Figure 6, except that an inductive resistance should be substituted for M. The secondary of a transformer with the primary open will suffice. The electromotive force of the primary terminals may be dangerously high. In the testing of high voltage circuits, not much reliance should be placed on insulation or on rubber gloves. The method of taking the curve is precisely the same as in the preceding experiment. The curves may be plotted as in Figure 8.

Determine the curve of watts or ei curve by multiplying corresponding ordinates of the e and i curves. The resulting curve consists of two positive and two negative areas per cycle.

Determine the average watts by adding algebraically the positive and negative areas and dividing by the length of the cycle. Multiply the mean ordinate of watts so found by the scale of watts, and the result should check with the wattmeter reading.

The product of amperes and volts as indicated by the ammeter I and the voltmeter V is called volt-amperes, and is greater than the watts derived from the curve. Volt-amperes multiplied by power factor will equal true watts. It will be seen that the current curve is not a

sine wave. The "equivalent" sine curve of current is a sine curve so drawn that the power factor = cos θ, where θ is the angle by which the current lags behind the electromotive force in reaching the maximum or zero values.

(Continued in next issue.)

A 100-MILE OIL PUMPING LINE.

BY A. M. HUNT.

SO far as the writer is aware, little or nothing has been published giving any data on the resistance to flow of oil in pipe lines. The subject is one of very considerable importance in California at the present time in connection with the cheaper methods for transporting our fuel oils, and it is thought that a description of the new six-inch line recently put in operation by the Coalinga Oil and Transportation Company, and of the method used in trying to predetermine the resistance to pumping may prove of interest.

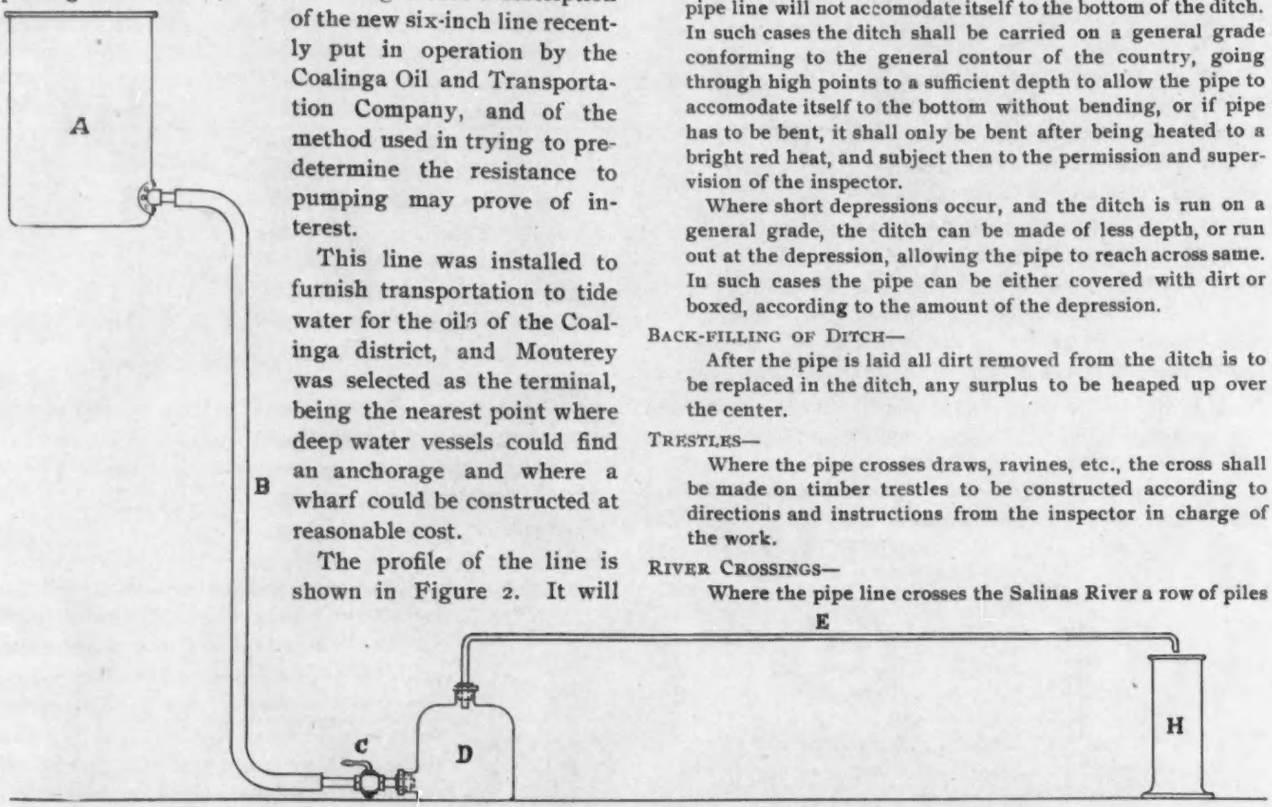


FIGURE 1. PIPE LINE MODEL USED IN DETERMINING RELATIVE RESISTANCE TO FLOW OF VARIOUS OILS

This line was installed to furnish transportation to tide water for the oils of the Coalinga district, and Monterey was selected as the terminal, being the nearest point where deep water vessels could find an anchorage and where a wharf could be constructed at reasonable cost.

The profile of the line is shown in Figure 2. It will be noted that the starting point is at an elevation of 770 feet. After the first few miles the line climbs rapidly until it reaches its greatest elevation of 2560 feet at a distance of approximately 22.8 miles from its starting point. The grade is then down, with one secondary summit of 1720 feet elevation, until it reaches an elevation of 990 feet at a distance of 41.6 miles from Coalinga. It then climbs again, crossing the Topo summit at an elevation of about 1760 feet. From this point it gradually descends to the floor of the Salinas Valley, which it crosses, and then goes over a summit of about 525 feet before Monterey is reached.

The line is built of six-inch, lap welded, mild steel pipe, tested with hydraulic pressure to 1500 pounds per square inch before shipment. It is put together with screw couplings.

The following extracts from the specifications under which the work was done indicate the methods used:

TRENCHING—

Where pipe is carried on the county roads, or over grazing lands, a trench is to be dug 16 inches deep, the bottom of the trench being not less than 18 inches wide and with no projecting points inside of this width.

Where through and over ordinary farming lands, the trench is to be not less than 26 inches deep.

Where it is carried through sugar beet lands, to be not less than 30 inches deep.

Where the line is carried over hard rock, the pipe is to be laid on top of the rock, projecting points of which must be broken off, and the pipe secured as directed by inspector.

The trench is to follow the general contour of the country, excepting in places where the contour is so uneven that the pipe line will not accomodate itself to the bottom of the ditch. In such cases the ditch shall be carried on a general grade conforming to the general contour of the country, going through high points to a sufficient depth to allow the pipe to accomodate itself to the bottom without bending, or if pipe has to be bent, it shall only be bent after being heated to a bright red heat, and subject then to the permission and supervision of the inspector.

Where short depressions occur, and the ditch is run on a general grade, the ditch can be made of less depth, or run out at the depression, allowing the pipe to reach across same. In such cases the pipe can be either covered with dirt or boxed, according to the amount of the depression.

BACK-FILLING OF DITCH—

After the pipe is laid all dirt removed from the ditch is to be replaced in the ditch, any surplus to be heaped up over the center.

TRESTLES—

Where the pipe crosses draws, ravines, etc., the cross shall be made on timber trestles to be constructed according to directions and instructions from the inspector in charge of the work.

RIVER CROSSINGS—

Where the pipe line crosses the Salinas River a row of piles is to be driven, with such spacing as is directed at the time; said piles to be cut off below the surface wash, and a trench dug on the up-stream side varying in depth from 2 to 4 feet below the surface, in which the pipe will be surrounded by a concrete casing with a section 20 inches square.

Stirrup bolts shall be used to hold the pipe to the head of the piles.

CLEANING THREADS—

Preparatory to laying each length of pipe the threads on the end of the pipe and in the collar shall be carefully brushed out, the pipe, at the same time, being blocked up so that the ends are free from the ground, and it must not again be laid on the ground until screwed in place.

If any threads are found bruised or damaged, they shall be trued up with hand taps and dies, a set of which must be kept with each pipe laying gang for that purpose.

PREVENTING OBSTRUCTIONS GETTING INTO PIPE—

To prevent obstructions getting into pipe and being left there, or to prevent small animals from crawling in, an

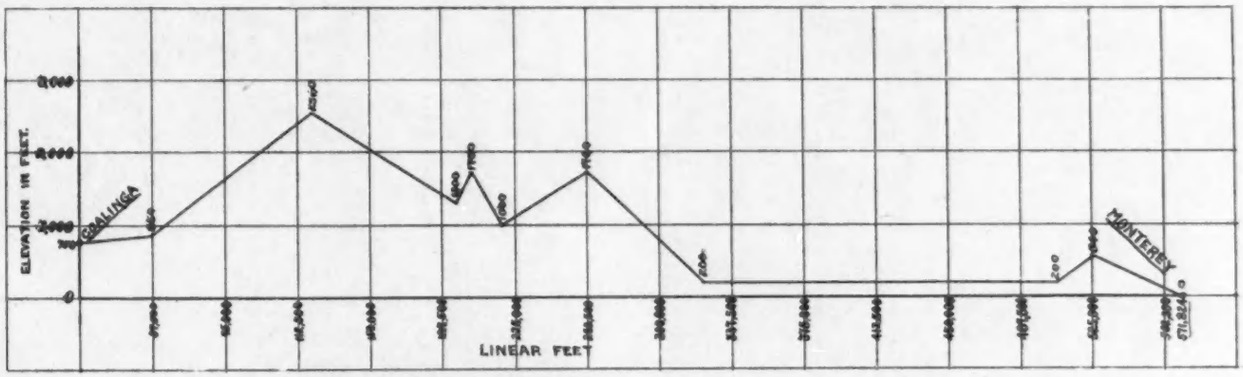


FIGURE 2. PROFILE OF COALINGA OIL AND TRANSPORTATION COMPANY'S PIPE LINE FROM COALINGA TO MONTEREY

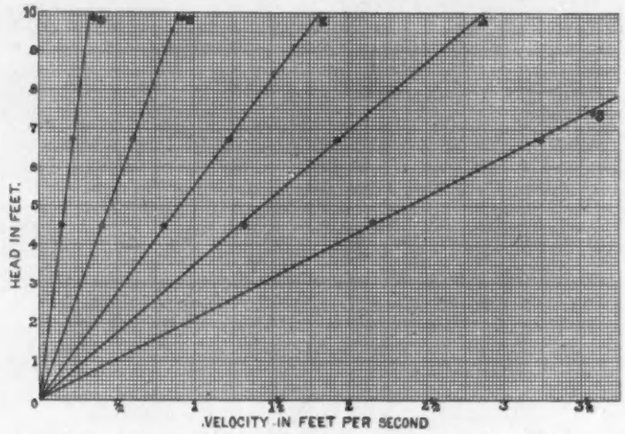


FIGURE 3. CHART SHOWING VELOCITIES OF FLOW IN PIPE LINE MODEL WITH VARYING HEADS

ordinary sack of such size as to practically fill the bore of the pipe shall be placed in the first section laid, and to it shall be tied a rope of a length greater than one section of pipe. Before the next section is screwed in place the rope shall be threaded through it, and after it is screwed in place, the sack shall be drawn up within two feet of the open end of the pipe where it shall be left until the next section is screwed up.

This precaution must be carefully observed, and special attention must be given to it, and special attention is directed to the fact that should the sack used, by any manner, be left in the pipe, by the breaking of the rope or otherwise, it would be fatal to the operation of the line.

CENTERING PIPES—

In screwing up the line it should be so supported that it can be screwed up for a considerable distance by hand, care being taken that none of the pipe is cross-threaded.

SCREWING UP PIPE—

When the pipe is screwed up as far as possible by hand, it shall then be secured in place by 8 Kline tongs, using two men on each tongs, and be screwed up by having the sixteen men press down together on the 8 tongs at the same time until it resists the pressure of their combined weight.

HAMMERING COLLARS—

At the same time that the pipes are being screwed into place, the collar on the end of the pipe, in which the last pipe is being screwed, shall be tapped lightly with a hammer.

LUBRICATING THREADS—

Just before entering each length of pipe, its thread shall first be lubricated with a mixture of oil and graphite, to be furnished by the company at the nearest railroad point, the contractor to receive and care for same during use.

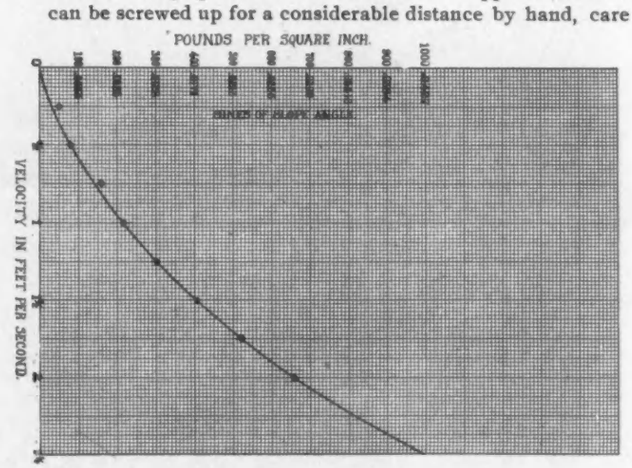


FIGURE 4. CURVE OF PRESSURES AND VELOCITIES WITH OIL IN FOUR-INCH PIPE LINE FOURTEEN MILES LONG

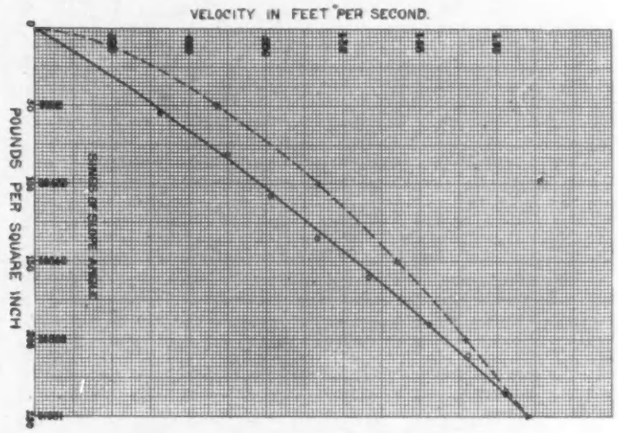


FIGURE 5. CALCULATED AND TEST CURVES OF PRESSURES AND VELOCITIES IN SIX-INCH PIPE LINE

ADJUSTING PIPE—

Wherever the laid line shows any tension, or does not rest easily in the ditch, the pipe shall be heated to a bright red heat, so as to allow it to conform to the shape of the ditch.

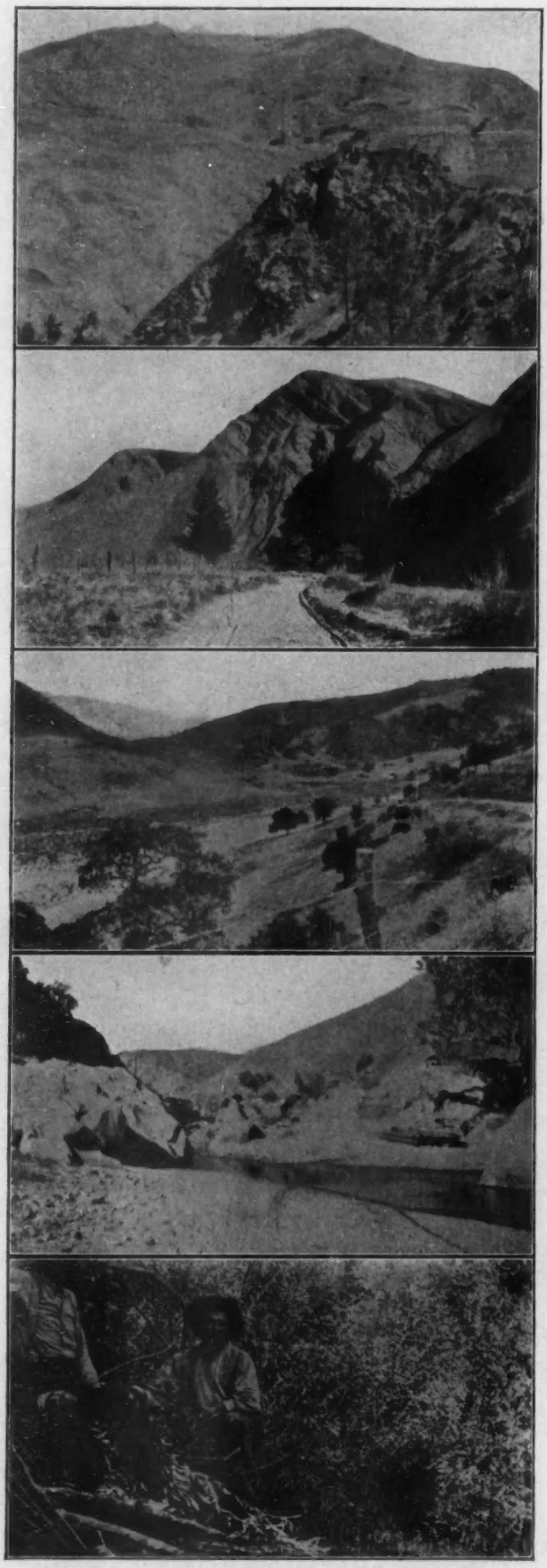
COVERING PIPE—

No pipe shall be covered after 9:00 a. m. and before 9:00 a. m. each day all pipe screwed up the previous day must be covered. Surplus earth shall be heaped up over the trench.

Where the line covers long stretches of straight ditch, the pipe is to be laid in the ditch zigzag, that is the pipe first touching one side of the ditch and then the other at points about 100 feet apart, or at the shortest points that the pipe will naturally spring.

TRESTLES AND BOXES—

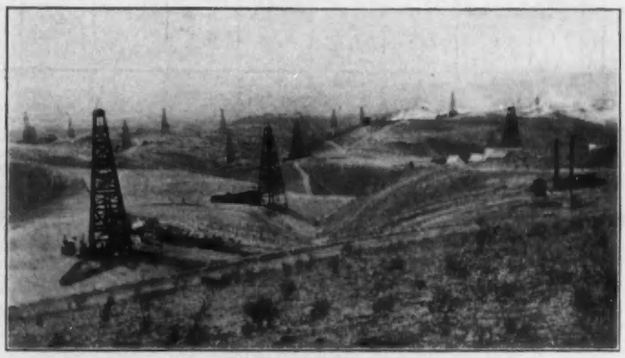
Wherever pipe is not buried it is to be neatly boxed, using two-inch merchantable Oregon pine lumber.



SOME CHARACTERISTIC VIEWS OF THE COUNTRY TRAVERSED BY THE MONTEREY-COALINGA OIL PIPE LINE

Where trestles are to be built they shall be constructed according to the directions of the inspector in charge of the work.

It was decided, after full consideration, not to put any heat insulating covering on the line. Considerable of the oil to be handled would not permit of heating to high temperature without formation of gas, and it was believed



A TYPICAL VIEW OF THE COALINGA OIL FIELD

that what heat could be added would be lost in a relatively short length of the pipe even if insulated. Furthermore, any commercial insulation would lose its value in wet weather unless rendered proof against moisture in some way.

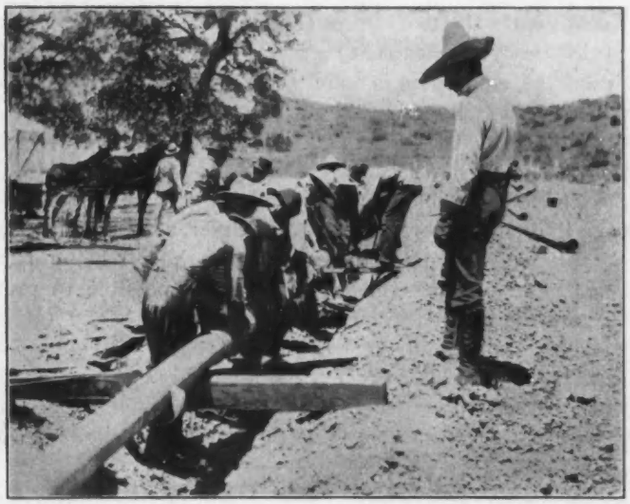
No air valves were installed, but a few air cocks were placed at the major summits. So far as can be determined

LAYING THE PIPE LINE NEAR THE INTERMEDIATE PUMPING STATION

after a month's operation, the line shows no tendency to become gas-bound by accumulation at summits.

The line is provided at each station with pockets and valves so that "go- devils" can be inserted or removed.

The laying of the pipe began on June 6, 1904, and was completed October 9, 1904. The main line is 108.3 miles in length, and the field lines aggregate about twelve miles. Of the total length of pipe line, twelve miles of pipe was furnished by the National Tube Works, of

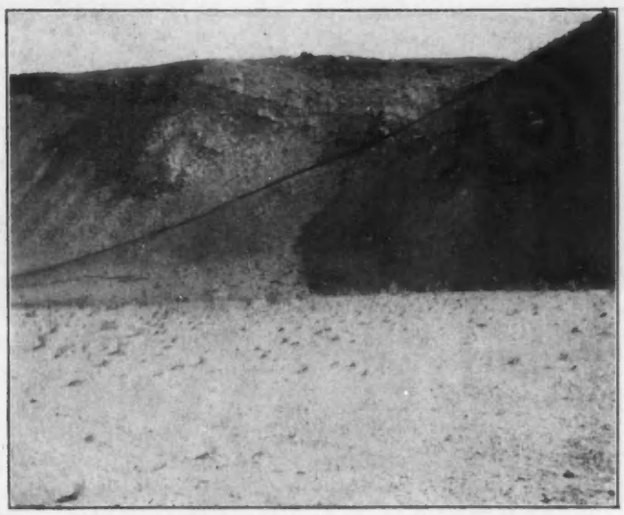


THE PIPE LAYING GANG SCREWING UP THE PIPE BEFORE PUTTING ON THE TONGS

McKeesport, Pa., the remainder, or approximately ninety-six miles, being furnished by the Wheeling Steel and Iron Company, of Wheeling, W. Va.

The line was tested after completion with 1000 pounds water pressure applied by the regular station pumps. When the rapidity of construction of the line as above indicated is considered, it is remarkable how few defects were discovered. A number of slight collar leaks were found, which were stopped with clamps and later by caulking. One length of pipe was cracked about two-thirds the way round, at the shoulder of thread, apparently done in the effort of bending the length. Two lengths of pipe were split while pressure was being applied. Such results speak very highly for the quality of material and workmanship, and more than all for the thoroughness of the inspection. The number of pumping stations installed is four, but connections have been placed in the line for four more in order to ultimately double its capacity.

The Lacy Manufacturing Company, of Los Angeles, Cal., built and erected the oil tanks, which consisted of two of 55,000 barrels capacity each at Monterey; one of 36,000 barrels capacity at Coalinga and five of 10,000 barrels each at various points along the line.



HOW THE PIPE LINE CLIMBS THE HILL ABOUT SIX MILES FROM COALINGA

Each station is equipped with two return tubular boilers and one Dow duplex, outside packed plunger pump, with a capacity of 6000 barrels a day against 1000 pounds pressure at moderate speed. These pumps are operated non-condensing, but a considerable portion of the exhaust steam is saved for feed water by being condensed in the feed water and oil heaters. This latter is a plain steel drum with two-inch iron tubes through which the oil passes, and is placed on the suction side of the pump. The pumps are equipped with both speed and pressure governors. The entire station layout is made as simple as possible.

In arriving at the requisite number of pumping stations and their location roundabout methods had to be employed owing to lack of data. Such meager information of lines as could be obtained was figured over, but owing probably to lack of care in recording data and the extremely varying character of the different oils, results were very unsatisfactory and discordant.

THE COALINGA OIL TRANSPORTATION COMPANY'S WHARF AT MONTEREY

To get at the relative resistance to flow of oils from different sources, the apparatus shown in Figure 1 was rigged up. It consisted of a can, *A*, of about five gallons capacity, connected by the rubber hose, *B*, to the side outlet of the glass jar, *D*, having a capacity of about one-half gallon. A stop-cock, *C*, was placed at jar. A glass tube, *E*, having an internal diameter of about five-sixteenths inches and about five feet long was inserted in cork in top outlet, and its other end secured over receptacle, *H*.

The can, *A*, and jar, *D*, to above side outlet being filled with water, oil would be poured into *D* until it was filled. *A* would be raised or lowered to give the desired head to produce flow. The stop-cock being opened enough to fill the tube, *E*, everything was ready for a run. The stop-cock would be opened wide, and with a

stop watch the time necessary to pass through the tube a given quantity of oil could be accurately determined.

Two points were located on a pressure velocity curve for a number of samples. A few of the results are shown by Figure 3, the different samples being indicated by numbers and letters. Reference will be made to some of them later.

It was found that in every case a straight line through the two points for any sample passes through the origin or point of zero head and velocity. In several cases more points were determined which indicated that the curve is a straight line with the apparatus in question, and for the limits within which the experiments were made.

It was found that the temperature of the sample had a very important influence. It was also noted that oils of the same specific gravity would sometimes give widely different results.

The people interested in the line under discussion had a four-inch pumping line in operation in Santa Barbara County with a length of about fourteen miles. I had this line operated at different velocities, noting the gross pressures at station. I corrected results for varying elevations of line to get pressure of frictional resistance to flow, and the results are plotted as a pressure velocity curve in Figure 4. On the pressure axis is also noted the corresponding sines of the angles of slope. This curve, with extension of same to a velocity of two and one-half feet per second, corresponds very closely with the equation $v = c\sqrt[5]{s^3}$, where c has a value of 17.

I had a sample of the oil which was being pumped through the line when test was made sent to me, which was run as above described in what I may call the pipe line model, the result being as shown by the line marked E in Figure 3. I then procured samples of the various oils from the Coalinga district, which were to be run through the line, and made a mixture of them in the proportion in which they would be in the receiving tank in the field. This mixture was run through the pipe line model at the same temperature as oil E, and result is shown by line A in Figure 3.

It was then assumed that the coefficient c in the formula $v = c\sqrt[5]{s^3}$, would for four-inch pipe and oil A be 17 multiplied by the ratio of velocities in pipe line model at the same head, $17 \times 1.53 = 26.0$. It was furthermore assumed that the coefficient for the six-inch pipe would be that for the four-inch, multiplied by the ratio of the square roots of their mean hydraulic radii. This would make the coefficient of the oil A in the six-inch line $26.0 \times 1.22 = 31.7$.

Having this coefficient, a curve showing probable velocities for varying sines of slope angles was plotted as shown by dotted line in Figure 5. On the same sheet is plotted, as shown by full line, the results of a careful test of the first section of the six-inch line when in operation with an oil very closely approximating mixture A, and at about the same temperature as that at which the model tests were conducted. It is interesting to note how nearly the two curves coincide, except at the lower velocities. The capacity of the line with the present pumping equipment is about 6000 barrels per day.

It is not contended that the results obtained are exact, but they are at least entitled to be classed in the category of intelligent guesses.

I hope to be able to make a series of careful tests of the line with different oils and at different temperatures, and having this data, and samples of the oil being run during such tests, I believe it will be possible to predetermine what results can be obtained with any other given oil within fairly close limits.

The pipe line has proven an unqualified success, and has justified the sagacity of the officials of the Coalinga Oil and Transportation Company, which installed it.

NEW 30,000-VOLT, STEEL POLE, LONG SPAN, TRANSMISSION LINE.

IN THE JOURNAL, for July last, mention was made of a new steel pole line being constructed from the new steam turbine substation, No. 3, of The Edison Electric Company, in Los Angeles, to Inglewood, a distance of fourteen miles. This line is now in successful operation at 15,000 and 30,000 volts and is of unusual interest in being the only line of its kind. Although complicated lattice work steel poles with moderately long spans have been employed in Europe to some extent, and windmill tower poles used in a novel way in the Guanajuato transmission, no line has employed steel poles of a construction commensurate in size, weight and strength with ordinary wood poles so that they may be employed in like conditions of a limited space or right of way, such as on a curb or between property lines. These were the conditions to be met with in this case.

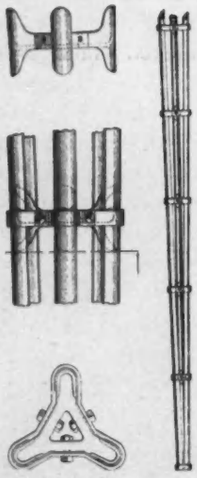


FIGURE 1

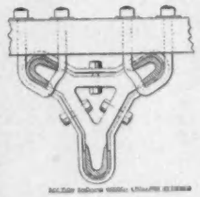


FIGURE 1A

Satisfactory results were obtained by using a steel U-bar pole of peculiar construction. The U-bars are from three-eights to one-quarter-inch in thickness, arranged 120 degrees apart around the axis of the pole which has the requisite taper. The bars are firmly assembled by means of inside and outside collars at right angles to the axis of the pole at two or three-foot intervals along its length, as shown in Figure 1. The poles up to sixty feet in length are made of continuous U-bars, while those of a greater length are spliced. It will be seen that this construction is extremely simple—all parts are exposed for painting, which is quickly and thoroughly done, and a minimum number of parts and joints always tends to minimize the decay of the pole at critical points of its strength. It will be noticed that the strength of the pole is in no place impaired by rivet or bolt holes.

Although the poles could be assembled on the ground, The Edison Company elected to have them made up complete at the factory. The poles are set 10 per cent. of their length in a cylinder of cement just large enough to enclose them, and a ground wire and plate is installed so that it is not possible to receive a shock from the poles in case the insulation of the line is imperfect.

By referring to the accompanying map, diagrams and photographs, the detailed construction of the line may be readily followed. The arrows on the map and numbered circles attached indicate how the respective photos were taken. From the map, Figure 2, it is seen that five three-phase circuits are carried for over a mile, where two of them at 15,000 volts each branch off to a separate steel pole line extending to local No. 2 substation up town, near Winston and Main streets, which distributes three-phase and direct current to the city of Los Angeles.

One local large power 15,000-volt circuit extends a mile or so farther at present, where it is deadened. A branch is taken off by means of a wood pole line to Simonds' brick yard, at this point crossing the river on a 560-foot span.

Two 30,000-volt lines extend to Inglewood, twelve miles farther, tying in the United Gas and Electric system recently absorbed by The Edison Electric Company with the original Edison system.

Photograph No. 4 shows the Inglewood line as it leaves No. 3 substation, Los Angeles. The poles are seventy-five feet in length, spaced from 250 to 275 feet apart, and

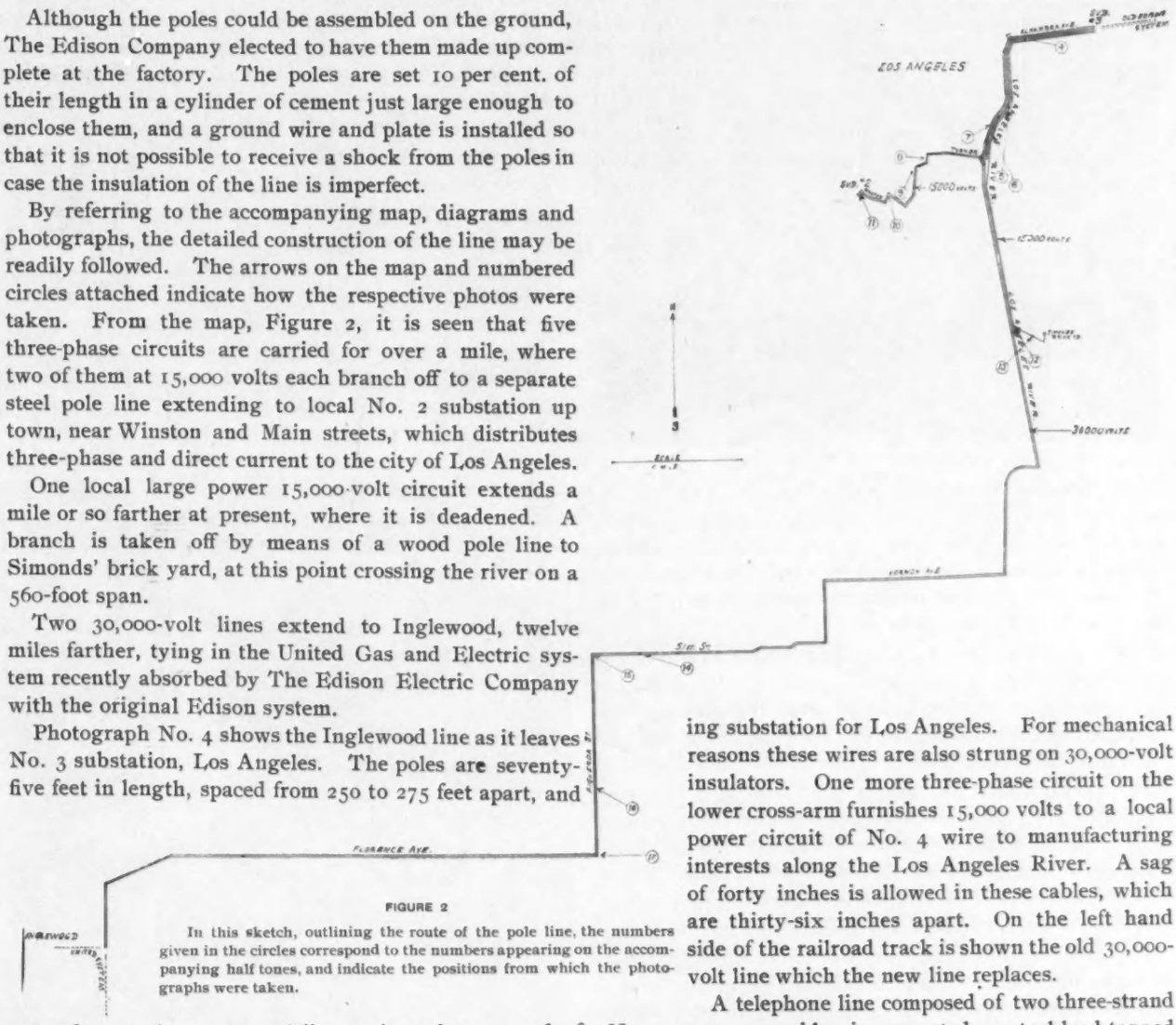


FIGURE 2

In this sketch, outlining the route of the pole line, the numbers given in the circles correspond to the numbers appearing on the accompanying half tones, and indicate the positions from which the photographs were taken.

carry four steel cross-arms (Figure 3), each composed of two U-bars ten feet in length, with the hub in the center to fit the pole, and firmly bolted together with blocks which contain lead topped standard thread steel pins.

The insulators are of a new special design adopted as standard for all 30,000-volt work by The Edison Electric Company. Two three-phase circuits are carried on the top cross arms for the Inglewood line at 30,000 volts, composed of No. 4 seven-strand medium hard drawn copper cables. Two circuits of No. 00 seven-strand bare copper cable are also carried on this line and operate at 15,000 volts.

They are designed for exchanging a maximum of 10,000 kilowatts between No. 3 and the uptown distributing substation for Los Angeles. For mechanical reasons these wires are also strung on 30,000-volt insulators. One more three-phase circuit on the lower cross-arm furnishes 15,000 volts to a local power circuit of No. 4 wire to manufacturing interests along the Los Angeles River. A sag of forty inches is allowed in these cables, which are thirty-six inches apart. On the left hand side of the railroad track is shown the old 30,000-volt line which the new line replaces.

A telephone line composed of two three-strand No. 12-13 copper cables is supported on steel lead topped brackets four feet below the lower eventual cross-arm.

Photograph No. 5 shows this line rounding a curve with 125-foot spans and poles guyed 500 feet across the river.

Photograph 6 shows a double cross-arm angle pole construction, the same being side and line guyed. It also shows the method of splicing the seventy-five-foot poles.

Photograph No. 7 shows the double six-pin twelve-foot cross-arm construction for maximum height above other intersecting high voltage lines. Two No. 00 three-phase circuits branch off up Turner Street to supply the uptown No. 2 substation above mentioned. There are

FIGURE 3

FIGURE 4. STEEL POLES IN SOUTHERN CALIFORNIA

seven companies running separate pole lines in Los Angeles. The difficulty encountered in running a seventy-five-foot steel pole line in such a city may be imagined.

Photographs 8 and 9 show a little of the difficulty in the way and also the method of raising the poles by means of a boom and a pole raising wagon.

Photograph 10 shows the cross-arming of a right angle seventy-five-foot corner pole.

This branch terminates in a double cross-armed dead-end pole and a pot-head pole shown at the right of Photograph No. 10. From the latter extend 15,000-volt Standard Underground Cable Company's paper insulated lead and steel covered jute protected cables conducted down the pole by clamps and channel bars. These cables, although only 500 feet long, are made necessary by the limitations of the underground conduit area. They are laid just as they are in a ditch and protected only by a board on top.

Some of the power at 15,000 volts, after being regulated in the No. 2 substation, is carried back through similar cables to a pot-head pole line to small lighting substations at centers of lighting distribution. This construction is on the other side of the street, shown at the left side of Photograph 11.

The 15,000-volt local power distributing circuit is carried on the Inglewood line for some distance beyond Turner Street, and from Turner Street wood cross-arms are used instead of steel (Figure 1A).

FIGURE 5. STEEL POLES IN SOUTHERN CALIFORNIA

Photograph No. 12 shows this construction, the two 30,000-volt circuits being on top. It also shows one end of the 560-foot span composed of three No. 6, seven-strand copper cables, dead-end on four insulators in tandem. To get the wires six feet apart on the twelve-foot cross-arm, the bridle was made as shown on the right of the pole by means of an annealed twisted copper tube. The cross-arms on these poles, which are now fifty feet in length and spaced 300 feet apart, are twelve feet long and wires forty-five inches apart.

Photograph No. 13 shows the other end of this span on a sixty-foot cedar pole.

Photographs 14, 15, 16 and 17 show the regular construction on forty-foot poles after the lower local distributing circuit has been dropped off.

Photograph No. 14 shows a transposition in the line

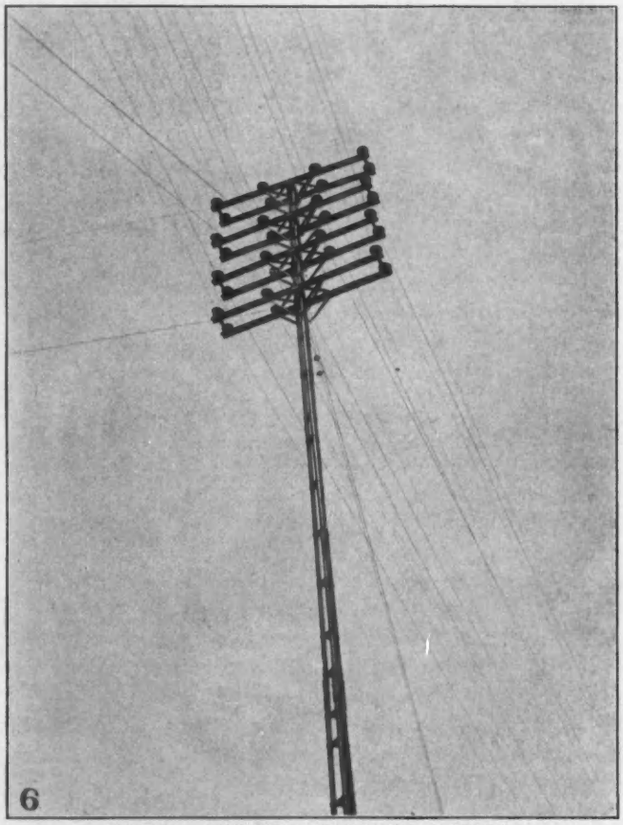


FIGURE 6. STEEL POLES IN SOUTHERN CALIFORNIA

effected by simply inverting the cross-arm construction.

Photographs 15 and 17 show the double cross-arm corner pole construction made self-sustaining without guys by means of a truss.

The steel poles and cross-arms for the line were built by the Franklin Rolling Mill and Foundry Company, Frankling, Pa. The lead topped standard thread pins were made by the Oliver Iron and Steel Company, Pittsburg, Pa. The porcelain insulators, which were designed by The Edison Electric Company, were made by the R. Thomas Company, East Liverpool, Ohio, and the copper cables were furnished by Waclark Wire Company, of New York.

The line was designed by Clem A. Copeland, at that time superintendent of distribution, who also supervised the installation.

PORCELAIN INSULATORS: THEIR MANUFACTURE AND TESTING.*

BY H. W. CROZIER.

AS porcelain is now recognized as the only satisfactory material for insulators, particularly for pressures of ten thousand volts and over, a short description of methods of manufacture and testing may be of interest. Electrical engineers working on advanced lines will be interested in knowing that porcelain

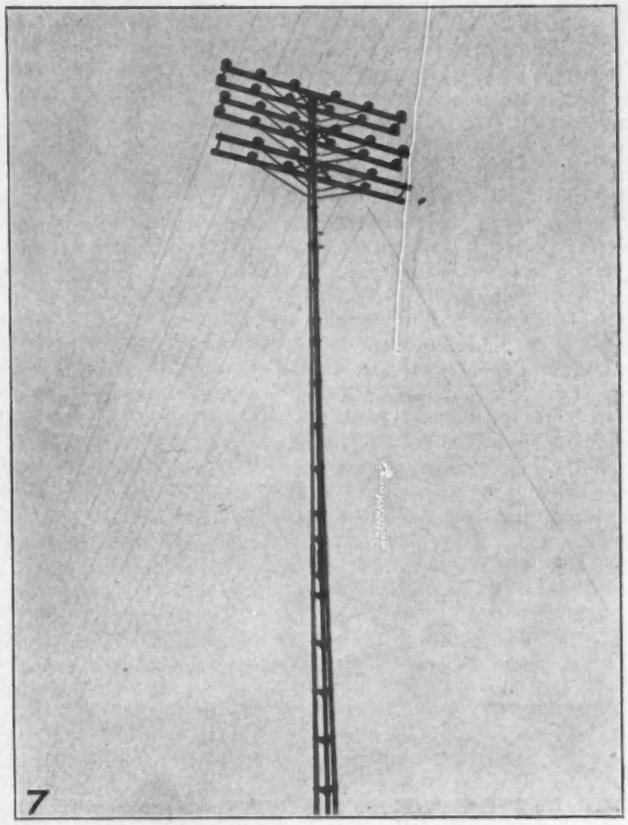


FIGURE 7. STEEL POLES IN SOUTHERN CALIFORNIA

can be made in any desired shape or form by following certain methods in the design of the parts. As the shrinkage from the wet clay to the finished article is 15 per cent., square corners and great thicknesses are debarred.

Pieces should be designed for as near uniform section as possible and changes in thickness can only be obtained very gradually. As a rule a thin piece of porcelain will have as high a dielectric strength as a thick piece; so that, save for mechanical reasons, there is no advantage in making pieces more than three-sixteenths of an inch thick, as a piece three-sixteenths of an inch thick will stand 50,000 volts test for one minute. In large insulators pieces up to three-fourths of an inch or one inch thick may be made, but three-fourths of an inch should not be used except in the very largest sizes—fourteen inches in diameter and over. In ordinary work one-half inch to five-eights of an inch should serve every purpose, and insulators made up of two, three, or even four shells can be easily made. The parts can be put together with Portland cement or with glaze and are mechanically as strong as if made of one piece. Electrically, insulators made of many pieces are superior to solid ones on account of the higher dielectric strength of the pieces.

The usual methods of the pottery are used for working the porcelain and but few variations are introduced. The screw thread offered difficulties for years; but the introduction of a valve in the bottom of the screw-forming tool to allow entrance of the air as the tool was withdrawn overcame this difficulty. The screw thread is not used in Europe-made insulators, as screw machines are used only in this country. The equipment for clay working consists of ball-mill and filter press with pumps. The ball-mill usually consists of a wooden tank eight feet in diameter and eight feet long, in which the clays are put with sufficient water to make a very liquid mixture. Quartz pebbles, which are obtained from glacial drifts in Greenland and brought here as ballast, are also inserted in the ball-mill for the purpose of thoroughly pulverizing the clay. The ball-mill is run about three hours, when the liquid clay is run into a tank which contains a stirrer so that the clay may be kept in that liquid condition until needed.

The filter press consists of a rack containing cast iron plates with canvas bags set between the plates. Each plate and canvas bag has a hole in the center through which the liquid is pumped by a force pump. The canvas is of such quality that the water only will leak through, and the clay will be retained. After pumping about an hour the pressure finally reaches 150 pounds and the press is found to be full. The press is then opened and the clay removed and put in storage.

There are two general processes used in the manufacture of porcelain insulating articles: One called the dry process and the other called the wet process. The essential feature of the dry process is the use of steel dies in which dry pulverized clay is placed and pressed to the form desired. The forms may be of any desired shape, provided there is sufficient arrangement made for withdrawing the dies. Holes may be inserted and the dies are very similar to molds used in casting iron and other metals, with the exception that no cores can be used, save such as can be made a solid part of the die, or withdrawn with the die.

In the wet process all the work is done in plaster dies and each factory contains a plaster department where dies and forms of all kinds are made. The method is quite simple. A block of plaster is taken as near the shape of the finished article as convenient and put in a lathe and turned to the desired form. Other parts which cannot be put in a lathe are formed by means of file and knife, as the plaster is quite easily cut. The pattern is made considerably larger than the desired finished article and the shrinkage allowed is usually one-seventh, for the wet process, although this varies with the type of clay, and with the amount of moisture present, but is usually a constant in any one factory. The finished pattern is smeared with oil, for the purpose of keeping other plaster from sticking to it, and cast-iron forms are used which determine the shape of the outside block. These are set over the pattern and liquid plaster poured in, making the finished mold. Molds are made in two or three pieces, depending on the size and shape of the article desired. Usually, however, two pieces are sufficient to allow for projections. Large insulators, however, require three pieces, which are made in the form of one large ring

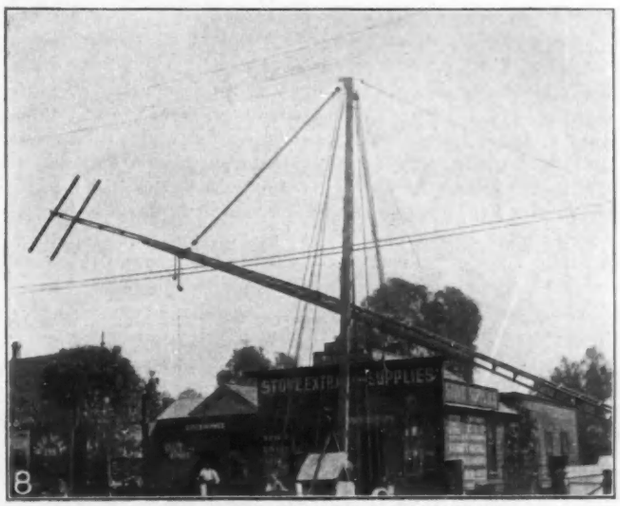


FIGURE 8. STEEL POLES IN SOUTHERN CALIFORNIA

*From *The California Journal of Technology*, Volume IV, page 91, October 1904.

FIGURE 9. STEEL POLES IN SOUTHERN CALIFORNIA

and two smaller pieces, to take the center part of the insulator where the wire is tied.

There are two general ways of making insulators by the wet process, one "jiggering" on a wheel and the other pressing in a rotating press. The jiggering method is the ancient potter's wheel, used with plaster dies. The plaster die is set on the wheel and tempered clay put in it and pounded down to fill the mold. The wheel is rotated and the clay worked by hand to the desired shape with the aid of a "former" of wood or iron which is supported near the wheel and pressed into the rotating mass of clay by the workman.

The machine for making the screw thread of an insulator consists of a frame holding a traveling screw and stationary nut. The screw is rotated in either direction by means of friction clutches and there is a stop and cut-off so that the travel of the screw can be regulated. A plaster die with an iron holder is set beneath the screw and the screw is started by means of a pedal. On the end of the screw is a tool made of crucible steel which is in the shape of the desired cavity in the insulator. A small valve is in the bottom of the screw-tool to allow the air to enter when the screw is withdrawn from the soft clay. The machine is operated very rapidly and the screw runs about 200 revolutions per minute. Other forms which do not have a screw are made on this machine also, provided they are not any larger than about ten inches in diameter and ten inches deep.

All insulators made are left in the molds and stacked up in the factory for about six hours, after which time the plaster has absorbed enough of the moisture so that the parts may be handled if care is taken. As soon as the pieces can be handled without distortion they are taken to wheels and laid on plaster forms. The outside parts, or parts which have been in contact with the plaster molds, are finished off smooth. Finished insulators are set in the drying room and kept about two weeks, after which time the clay is thoroughly dry and quite hard,—so hard in fact that it is necessary to use a knife to make any impression upon it.

In the dry process the clay, after coming from the filter presses, is worked in a pug mill and re-pressed in other filter presses. The re-pressed clay is dried and is then ground up until it is much finer than sugar, when it is sent to the machine room. It should contain enough moisture to adhere if strongly compressed.

The machines used for pressing the clay are as a rule worked by means of cams and fly-wheels to obtain the requisite pressure. Hydralic presses are used to a certain extent for the larger pieces, but do not work fast enough on the small sized pieces to suit most managers. This does not mean that hydraulic presses will not work well on small pieces; because, by means af multiple dies, sixteen, twenty-five or thirty-six pieces, or even more, may be made at one stroke. The dies are quite costly, however, and require the highest skill for their manufacture. Knobs, cleats, socket parts, fuse blocks and other pieces which must be made to exact demensions, are made by the dry process, but as a rule nothing larger than about one pound is attempted.

Tubes are made by squirting wet clay through a die by means of a steam-operated machine. The machine consists of two cylinders in a vertical position; the upper one, for steam, about twelve inches in diameter and provided with valve, etc., for its operation, and the lower one provided with a plunger about eight inches in diameter. A lump of clay is put into the lower cylinder and the plunger caused to decend. The clay is forced out of the die in the bottom in the form of a long tube from which pieces are broken off by hand and laid on a board. When twenty pieces are collected the board is passed to a second operator and all the pieces are cut to length at once by the simple operation of sawing off the ragged ends. The tubes are then taken to a machine which has a turret head holding eight mandrels just fitting the tubes. By pressing a pedal, an arm holding a die is caused to press against the end of one of the mandrels aud form the head of the tube. The turret head rotates at each stroke of the machine and the operator occupies himself with withdrawing the finished tubes and putting on others. Tubes are fired in a vertical position.

The dried insulators are taken to the glaze table and dipped in the glaze, which is simple a liquid clay which melts and forms a glaze at the temperature necessary to vitrify the porcelain body. After about twenty-four hours further drying the insulators are taken to the Kiln-room and placed in saggars and loaded in the kilns. If insulators are made of two or more shells and are not more than ten inches in diameter the parts may be united by putting them together with a little extra glaze, and firing the whole together. Saggars are pots made of burned fire-clay and are used to protect the insulators from the direct flames. The setting of a kiln is usually a very delicate job as the saggars must be piled up to a height of ten feet, and proper space must be left between each row of saggars to allow proper circulation of the flames and gases.

Kilns used for firing insulators are usually fourteen feet in diameter and ten feet in height, and have a brick floor with flues

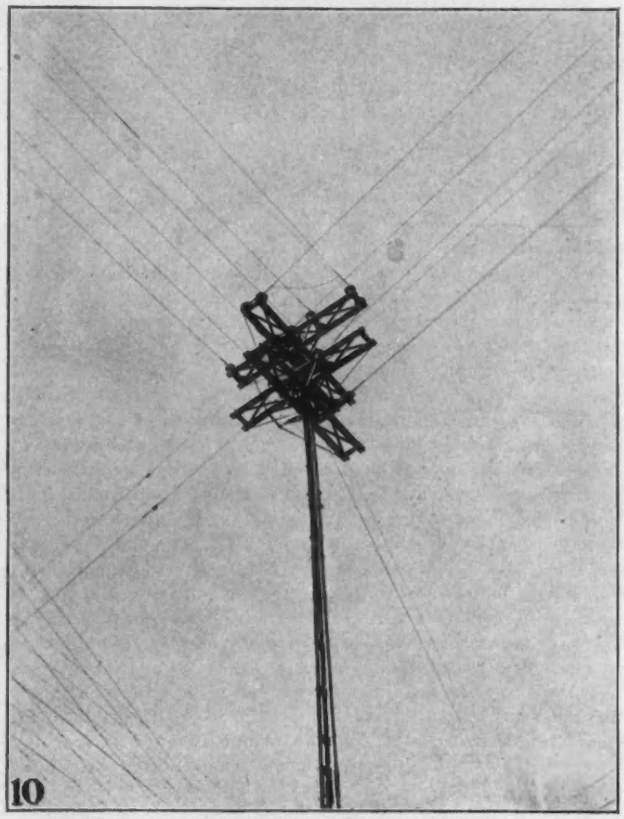


FIGURE 10. STEEL POLES IN SOUTHERN CALIFORNIA

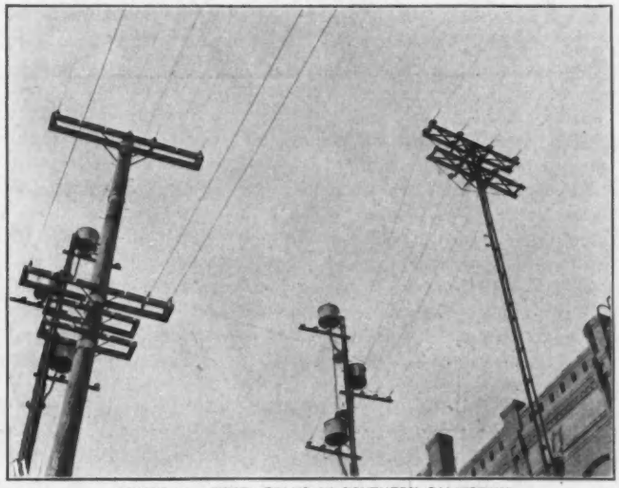


FIGURE 11. STEEL POLES IN SOUTHERN CALIFORNIA

underneath. In the best arrangement, an outside stack is connected by an underground flue. This gives a clear kiln and by proper arrangement of the flues an even temperature can be obtained clear to the bottom. Eight grates for a fourteen foot kiln is the usual arrangement, and either coal or gas is used for fuel. Gas is very convenient and is used where the supply can be relied on; but even where gas is plentiful the cheap potteries at times use coal because a failure of the gas supply might ruin a kiln of material.

Temperature measurements are made by means of small pyramidal pieces of porcelain called pyrometric cones. These are prepared at the Ohio State University and are made to melt at various temperatures. The potter accordingly selects four cones, one of which will not melt at a temperature which he intends to reach, and sticks them in a piece of clay, so that the cones stand in a vertical position and can be seen through peep-holes in the kiln. These holes are normally closed by fire-brick. A number of these sets of cones are put in the kiln and during the firing the fireman can tell quite accurately the condition of the kiln by watching the cones. As the temperature rises the cones melt one by one, and when all the cones but the highest numbered ones are melted the kiln is finished and may be cooled off. It takes about forty-eight hours to fire a kiln and twenty-four hours more for the cooling.

For the purpose of detecting faults in the finished porcelain pieces an electrical test should be made on all insulators to be used on 6000 volts or over. A convenient testing set consists of a number of 10,000 volt transformers, connected in series, and as many of these are used as is necessary to obtain the desired testing pressure. A single transformer can be used also; but the regulation at different voltages varies so much that a skilled operator is necessary. The dynamo should give as near a sine wave as possible, but this point is not essential, as a spark-gap is used to measure the pressure.

The pieces to be tested are set on pins on a rack, each pin having a conducting wire through its center. A wire stretched overhead has chains suspended from it and these chains are laid on the top of the insulator or attached to suitable electrodes. About thirty insulators are tested at once. The current is applied for a minute or more; when, if of sufficient intensity, the defective pieces speedily puncture and are removed. In the manufacture of large insulators, where details are watched, the proportion punctured will be about 8 per cent. but if care is not taken in the drying-room, the loss may be as high as 15 per cent. or even 25 per cent.

It is usually difficult to test insulators made of two or three

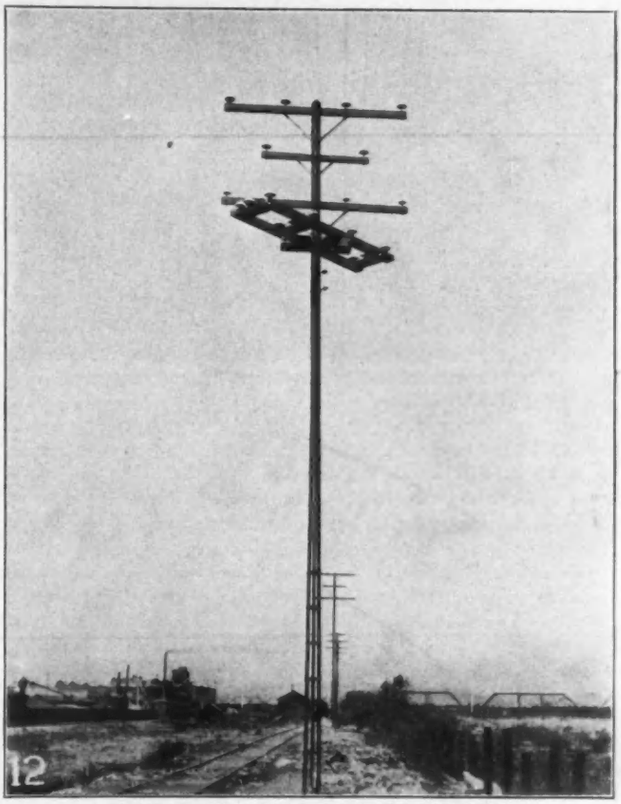


FIGURE 12. STEEL POLES IN SOUTHERN CALIFORNIA

pieces and glazed together, because sufficient pressure cannot be used for the proper searching out of faults. For this reason insulators cemented after testing are much safer, as it is then known that the seperate pieces are sound. As a a rule there is no reason for testing complete insulators whose pieces have been previously tested, unless it is desired to watch their behaviour under test. Insulators should be designed to stand any pressure which can be applied to them; that is, they should stand a pressure which will maintain an arc clear around them. This makes, with an iron pole, an efficient lightning check and may be used in the future as an additional safeguard.

Water is sometimes used as an electrode for testing purposes, as it is supposed to flow into cracks, if present, and search out weaknesses. Its usefulness is questionable as it has a tendency to increase the leakage over the surfaces and to distribute the pressure. On account of the leakage over it is usually impossible to obtain as high a pressure on a piece of porcelain as if tested dry and the current keeps arcing over. The use of water also interferes with the final inspection, which should be made before shipment.

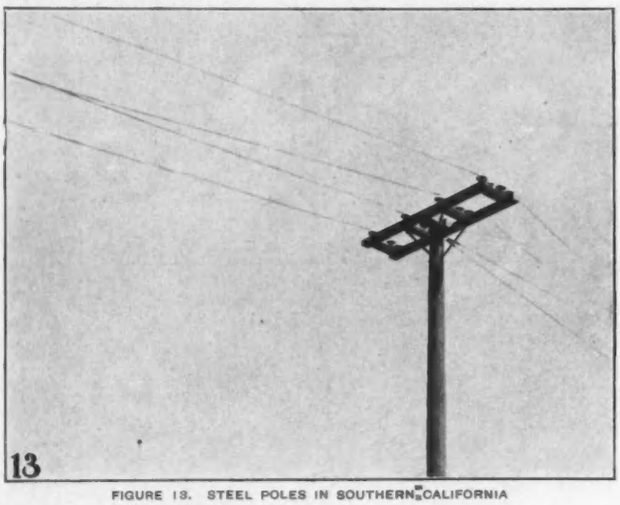


FIGURE 13. STEEL POLES IN SOUTHERN CALIFORNIA

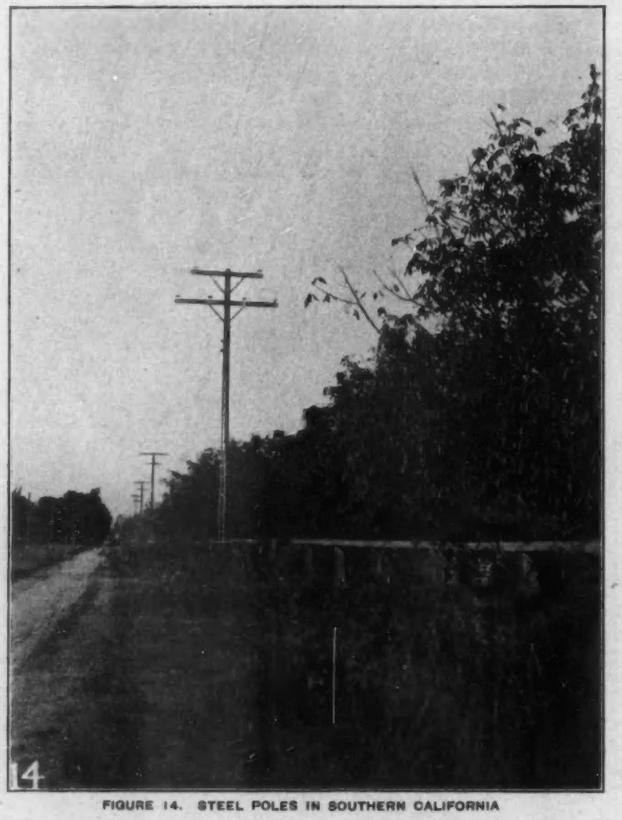


FIGURE 14. STEEL POLES IN SOUTHERN CALIFORNIA

LONG SPANS FOR TRANSMISSION LINES.*

BY F. O. BLACKWELL.

MANY cities today are dependent for their lighting, transportation, water supply and the operation of their industries upon electric power transmitted over considerable distances.

Unfortunately, interruptions of the power service occur not infrequently, and when they do happen they so inconventence the public as to be most conspicuous. The impression that long-distance power transmissions are unreliable has some basis of fact that seriously interferes with their development. Although absolutely continuous service may not be possible, many of the troubles now experienced can be either altogether eliminated or greatly reduced. Among the principal causes of interruption, so far as the line is concerned, may be mentioned:

Short-circuiting the lines by branches of trees, wires, or by large birds getting across them.

Burning of wooden pins, cross-arms and pole tops by leakage or electrostatic discharges from the conductors.

Burning of wooden poles at the ground from forest or prairie fires.

Failure of insulators from puncture by the current or their destruction by missiles discharged maliciously.

Lightning damaging the apparatus connected to the circuits and sometimes destroying poles.

Accidents due to heavy winds overturning the poles or to floods washing them out.

The deterioration of a line requires its replacement in from five to twenty years, depending on climatic conditions and the material which is used on its construction. This replacement of the poles with new ones can only be done by shutting off the current or at the risk of accidental interruptions.

Let us see what can be gained by substituting a steel tower construction with long spans for a wooden pole line. Short circuits are by far the most common difficulty, the only remedy for which is to put the wires so far apart that they are unlikely to be bridged across. This can readily be done even with more than one circuit when a steel cross-arm is employed. Burning is of course entirely done away with where metal construction is used.

Failure of insulators from electrical causes can be obviated by getting larger and better insulators; this is practicable where the spans are long and the number of insulators on high towers are much poorer targets than when they are near the ground and so are less liable to be broken.

Each metal tower is a lightning arrester, and as they are the highest points in the line they materially assist in its discharge; and the tower itself, being a conductor, cannot be injured by lightning. Steel structures can be exactly figured to meet safely any strains that can come upon them and can generally be located only at safe places where there is no danger of washouts.

The deterioration of a properly constructed and well galvanized steel tower is very slight, and is proved by marine and windmill experience, and is practically negligible so far as the pins and cross-arms are concerned. Any part of a steel tower can be readily removed and replaced without interrupting the service.

By far the greatest gain obtained from long spans is in the reduction of the number of parts. If one insulating support takes the place of four or five, line troubles will be reduced nearly in direct proportion, the inspection and repair of the line will be much simplified and its cost of maintenance correspondingly diminished.

The cost of a tower construction as compared with wooden poles depends on the locality. Where the right kind of timber exists it is, of course, cheaper; but in tropical countries, where wooden poles would have to be transported long distances, the towers are much less expensive.

The first and most important consideration for long spans is the material of the conductor. Copper, aluminum and iron are available for this purpose. Various alloys of copper have great strength, but their conductivity is too low and their cost too high to compare favorably with the more common metals. Copper wire varies widely in its characteristics, depending on the methods

FIGURE 15. STEEL POLES IN SOUTHERN CALIFORNIA

* Abstract of a paper read before the International Electrical Congress, St. Louis, September, 1904.

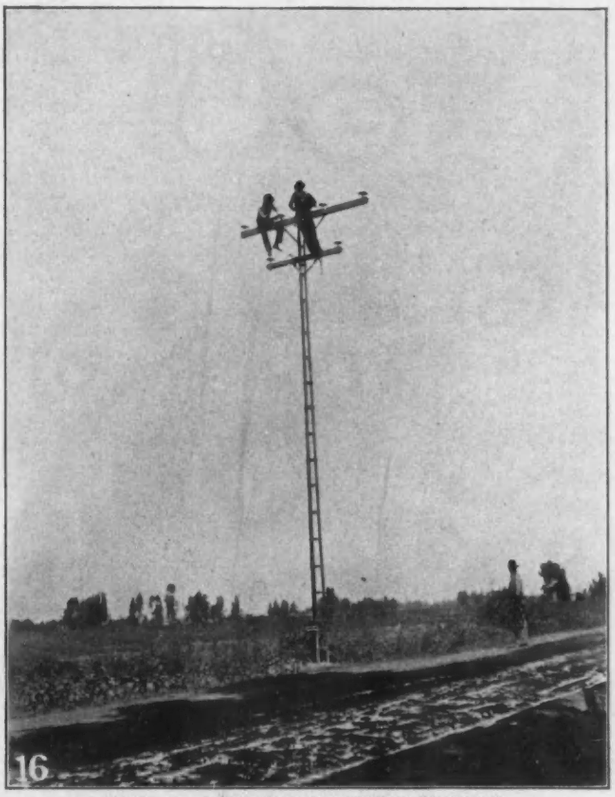


FIGURE 16. STEEL POLES IN SOUTHERN CALIFORNIA

used in its manufacture. The copper is received at the wire mill in the form of cast-wire bars, weighing 300 to 350 pounds. It is then rolled into rods and the rods are drawn into wire of the required size. The temperature at which the metal is rolled, the reduction of area both in rolling and drawing and the amount of annealing which the wire is given—all have an important bearing on its characteristics. As the size of the original wire bar is limited, the smaller the wire the more it is worked and in general the better the result.

Each strand should be a continuous wire without joints. Joints in the cable should be as few as possible and made by means of sleeves, as brazing or soldering anneals the wire and much reduces its strength.

The advantage of aluminum is that it weighs less than copper for the same conductivity, but for long spans its lesser strength, greater diameter and higher coefficient of expansion are against it. Steel wire has about nine times and iron wire cable about six times the resistance of copper, so they are more expensive as a conductor than copper. In order to avoid oxidization it is necessary to galvanize iron or steel wire; this partially anneals it and reduces its strength.

The strains upon the conductor are those due to its own weight and the wind acting upon its surface. In a cold climate in addition sleet may form upon the wire, increasing the weight and the surface exposed to the wind. On a line carrying any considerable amount of power it is improbable that sleet will ever form on account of the losses in the conductor slightly heating it. In order to be on the safe side, however, it is best to assume in the north a coating of ice one inch thick all around the conductor. The wind velocity could never exceed one hundred miles an hour, which would give a pressure of forty pounds per square foot on a flat surface, or twenty pounds on a cylindrical surface, such as that of a wire. The weight is, of course, a vertical stress and the wind a horizontal one at right angles to the wire. The greatest strain is caused by the resultant of these two. The worst conceivable condition is sleet on the wire, followed by extreme cold weather with high winds.

The maximum sag may be due to the conductor being loaded with sleet or to heating of the wire in a hot sun. The latter will generally be found to give the greater sag. Owing to the conductor being elastic, it is not necessary to consider the greatest deflection from a horizontal line between supports as the vertical sag of the wire. The wind pressure causes the wire to swing to one side, and it is elongated by the combined strain of wind and weight, but as soon as it is relieved of the wind pressure it swings back to a vertical position and contracts to the length required to carry its weight alone. The sag due to the heating of the wire is also somewhat less than it otherwise would be, because when expanded the strain is less and the wire contracts.

The cross-arm is, of course, subjected as a beam to the weight and wind strains transferred to it from the cable, but in addition there is a torsional strain, due to the breaking of a conductor, that can best be borne by a pipe. The length of the cross-arm should be sufficient to space the wires well apart and prevent short circuits either from objects thrown over the line or from the wires swinging together. The former is the more important, and if a safe distance apart, say six feet, is chosen, it will be sufficient to guard against the latter, as on short spans, with relatively less distance between wires, they invariably swing together and never touch each other.

The most economical tower construction is one in which the spread of the legs at the ground is about one-quarter to one-third the height of the tower. If a less spread is used the weight of the legs become excessive and with a greater spread the cross bracing must be much increased in size. For a single circuit the common windmill construction, in which the legs are braced together at the top, has the advantage of reducing the strains to a simple compression of the legs on one side and tension on the other, the only function of the cross bracing being to prevent the legs buckling when in compression. Where there are two or more circuits the length of the cross-arm is so great as to require two points of support. The tower can then be made with a width at the top approximating that at the bottom and the cross bracing has to bear its full share of the lateral strains. A truss construction with the fewest number of parts and opportunities for slack motion and racking of the tower is preferable.

FIGURE 17. STEEL POLES IN SOUTHERN CALIFORNIA

THE DICK-KERR HIGH TENSION OIL SWITCH.

BY EMILE GUARINI.

THE rapidly increasing and extensive application to present day requirements of high tension currents for the transmission of power has brought prominently forward the necessity of providing suitable and reliable apparatus for handling with safety currents of high potential. Soundness in design and care in construction are absolutely essential, for the slightest weakness or defect may disable the system of supply and lead to most serious results.

The high tension oil switch which Dick, Kerr & Co., Limited, of London, England, has placed on the English and Continental markets, possess some novel features, and as they are being largely used on systems at home and abroad, a short account of their construction and method of working should be of interest. The switches are supplied singly or in multiples to suit any number of phases and may be operated automatically.

Figure 1 is a good illustration of the hand operated oil switch, and its neatness in design and simplicity of working will at once appeal to all engineers interested in high tension switch gear. The illustration shows two separate switches, one with the switch opened, the other closed; in both cases the oil box is lowered, thus giving a good view of the switch blades. The main terminals for connecting the cables are secured to vertical rods which are highly insulated with mica sleeves and porcelain insulators, with large creeping surface, as shown on the right hand switch, Figure 1. They are held in position by substantial insulators securely fixed to a cast iron webbed plate. This can be better seen on the left hand switch (Figure 1), which shows the main terminals removed. The webbed plate acts as a cover to the oil box which surrounds the switches and is bolted to the cast iron frame. When the oil box is lowered the copper jaws which depend from the vertical rods are clearly seen. The switch blade is carried horizontally in a heavy porcelain insulator and attached to the turned steel rod, which is secured to the upper end of the cross-head, guide rods and weight. When in use the switches are entirely inclosed in the large oil box, which can, when required, be easily lowered by means of the winch attached to the frame shown in Figure 1. The oil box is lined with impregnated material and fitted with fireproof partitions consisting of marble or other suitable material for separating the various switches. It is also dust proof and oil tight and is fitted with an oil gauge, by means of which the height of oil in the box may readily be observed.

The top of the cast iron is provided with columns for supporting the trip gear, weight and horizontal cross-head from which depend the vertical rods which are attached to the switch blades. The trip gear is attached to a series of links which connect up through cranks to the operating handle mounted on the switchboard. To close the switch the handle must be forced down until the spring bolt locks. This motion raises the weight and cross-head and closes the trip gear and switch.

The switch may be opened by withdrawing the spring bolt and raising the switch handle. On releasing the handle the trip gear is immediately brought into action, the weight falls smartly on the cross-head and throws the switch blades out with a quick break action. In addition to the ordinary operating handle, each switch is provided with an emergency throw-out. This takes the form of a solenoid attached to the frame of the switch, the armature of which actuates the trip gear. The local circuit for operating the solenoid is closed by a small press-button switch placed immediately above the main switch handle on the board. These switches may be fitted with automatic overload and no voltage release.

Figure 2 is an illustration of a special type of oil break switch used for larger work. It is similar in design to the foregoing, but is operated by a motor, which does away with the link and crank gear which connect the switch to the switchboard.

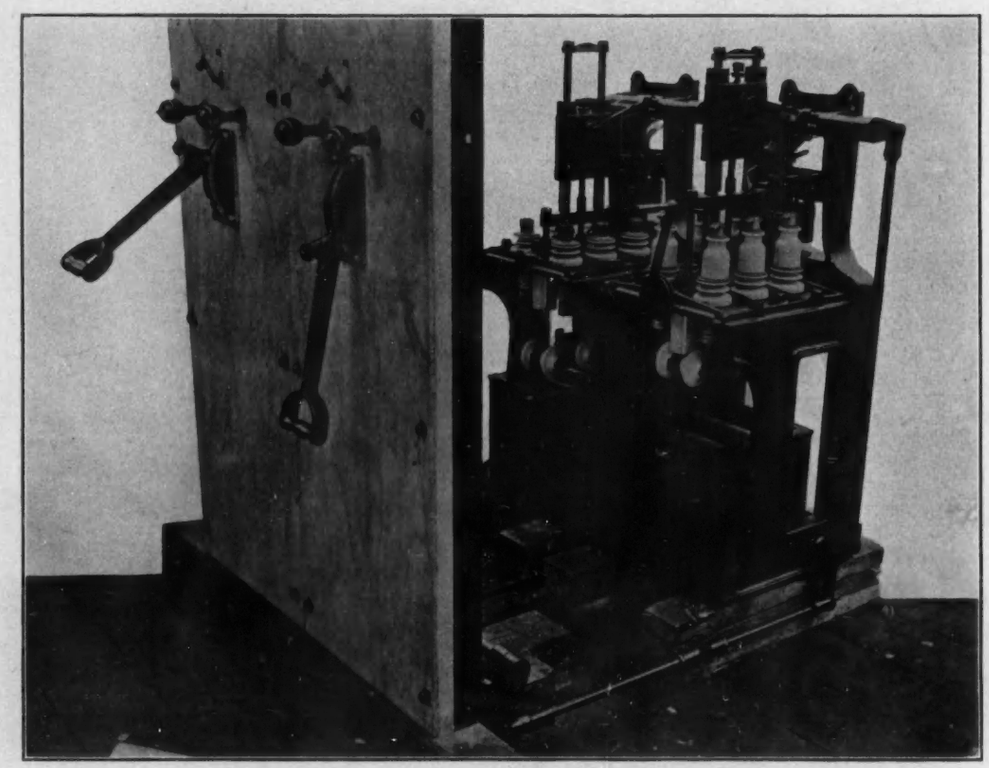


FIGURE 1. DICK-KERR-S HAND OPERATED HIGH TENSION OIL SWITCH

In place of the switch handle on the board is placed the small press-button switches marked "On" and "Off." These are joined up by clockwork and relay through a local circuit which starts and stops the motor. The motor is provided with a flywheel and gearing. The gearing actuates a vertical rod which engages the trip gear for releasing the weight placed above the switch frame.

The motor and gearing are made in the most compact form and fitted neatly under the switch frame, while the clockwork and relay are fitted at the back of the switchboard behind the press-button switches.

A FORTY THOUSAND HORSEPOWER GAS ENGINE.

A GREAT gas engine plant recently erected at the Lackawanna Steel Works, Buffalo, N. Y., is described in the current issue of an electrical contemporary,* and the installation which is especially noteworthy in that it utilizes waste blast furnace gases. Two power houses are being erected, and together they will have an ultimate output of 40,000 horsepower, nearly half of which is already developed. Power house No. 1 at present contains eight twin Koerting two-cycle double-acting gas engines,

**Electrical Review*, New York, Volume XLV, page 878, November 26, 1904.

each having a capacity of 1000 horsepower and directly connected to alternating and direct current generators. Three of these twin engines, which operate at a speed of 100 revolutions per minute, each drive a 500-kilowatt direct current Sprague-Lundell generator, and each of the remaining five units drives a 500-kilowatt, 25-cycle, 440-volt, General Electric three-phase generator. In power house No. 2 there are already installed five 2000 horsepower twin Koerting gas engines, each of which drives a 76-inch by 60-inch vertical blowing cylinder at a speed approximating 75 revolutions per minute. This station will ultimately contain sixteen similar units.

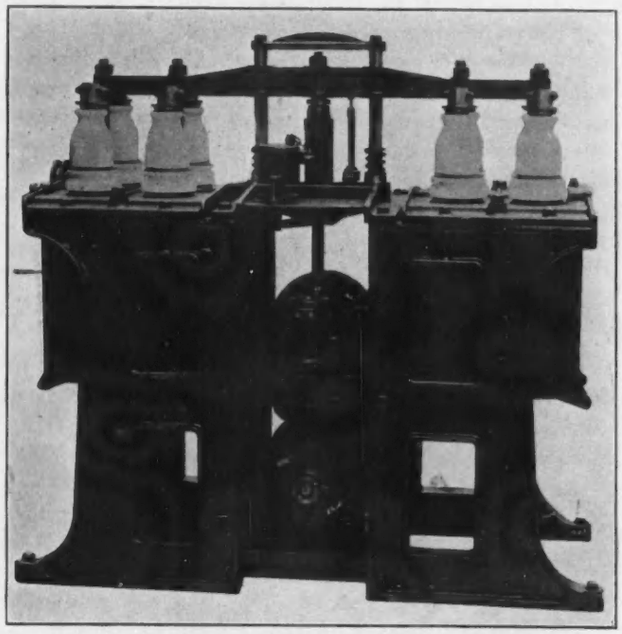


FIGURE 2. DICK-KERR'S MOTOR OPERATED HIGH TENSION OIL SWITCH

All these engines are operated with blast furnace gas having a heat value of 80 British thermal units per cubic foot of gas and their consumption of gas approximates 10,000 British thermal units per brake horsepower per hour, corresponding to a heat efficiency of 25.5 per cent.

These engines are of German design, but were constructed in this country, the 1000 horsepower unit being built by the De Lavergne Machine Company, of New York, and the 2000 horsepower unit by the Southwark Foundry Machine Company, of Philadelphia.

ALTERATING CURRENT TRACTION FROM GAS POWER.

A SOMEWHAT unique departure from established methods in electric traction has recently been undertaken at Warren, Pa. The Warren and Jamestown Street Railway Company is equipped with an alterating current single-phase electric railway system to operate between Warren, Pa., and Jamestown, N. Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse Companies at East Pittsburg, Pa.

The power station will be located at Stoneham, Pa., two miles from Warren. The initial equipment will consist of two Westinghouse gas engines each of 500 brake horsepower capacity. They will be of the horizontal single-crank double-acting type, direct connected to two 260-kilowatt Westinghouse generators furnishing current at voltage sufficient for direct use upon the high tension transmission line. The power equipment also comprises a fifty-five horsepower Westinghouse gas engine for operating air compressor and exciter unit. Natural gas will be used, furnished by the local distributing company. In this district the gas has a calorific value of about 1000 B. T. U. per cubic foot.

Transformer substations, five in number, will be located along the right of way. These will receive the high tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive power equipment will comprise four quadruple sets of Westinghouse single-phase motors each approximately of fifty horsepower capacity.

An interesting feature of the system is the arrangement for operating the alternating current motors upon the direct current trolley lines within the city limits of the termini.

The Warren and Jamestown Street Railway is not a newly organized system, as it has operated part of the present lines for a period of eleven years. Three years ago the company began experimenting with the use of gas power, with sufficient success to influence them in the now exclusive adoption of gas engines for their entire power generation. The operation of the new system will be watched with much interest by the engineering public, and its success will mark an important advancement in modern electric railroading.

LITERATURE.

"MAXWELL'S THEORY AND WIRELESS TELEGRAPHY", by H. Poincaré and Frederick K. Vreeland. New York: McGraw Publishing Company, 1904. 247 pages. Price $2.00.

This book consists of two parts, one of which deals with electrical waves from the general scientific standpoint, while the other treats of the methods by which such waves are utilized in wireless telegraphy. The first part, by Professor H. Poincaré, has been translated from the French by Mr. Vreeland in very satisfactory form, and will be found to give a remarkably clear presentation of the most important experiments and principles of electrical waves. When one remembers the reputation of Poincaré as one of the most eminent living mathematicians, one is surprised to find that this discussion of electrical waves contains not a single analytical or mathematical expression. Like most of the mathematical physicists who are really eminent, Poincaré has the ability of writing clearly in ordinary language as well as in mathematical symbols.

The second part, by Mr. Vreeland, is a discussion of the principles and methods of practical wireless telegraphy. Mechanical analogies, frequently quite ingenious and novel, are freely employed in explanation. As in the first part of the book analytical discussions are entirely absent. No attempt is made to develop the subject in all the multiplicity of detail which the present state of the art would admit. As the author says:—"This is not intended as a treatise on wireless telegraphy—no attempt is made to describe the myriad forms of apparatus nor to settle questions of priority and history. Such material is readily accessible to those who may desire it. The object is rather to deal with principles and to trace the developement of the art in its essential features. Where specific cases are cited they are chosen with reference to their fitness to illustrate an idea or to serve as milestones on the path of progress, and they are treated with a view to emphasize that which is essential and minimize superficial or unimportant details."

The author is remarkably successful in avoiding any evidence of bias in the numerous cases where disputes have arisen regarding priority of invention. The acrimonius discussions between Braun, Slaby Arco, Marconi, and the discussions of a somewhat similar kind between representatives of the different wireless telegraph companies in this country, are not considered.

In the opinion of the reviewer, this book is the best subject that has yet appeared. It should prove of great value to those who desire to get a clear understanding not only of the methods used in the art at the present time, but also of those underlying principles of wireless telegraphy which will remain unaltered as the art itself is developed.

Mr. I. B. Funk has been placed in charge of the plant of the Coalinga Power Company, Coalinga, Cal., The plant will be in operation about January 1st.

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VOLUME XV JANUARY, 1904 NUMBER 1

EDITORIAL.

ALTERNATING CURRENTS IN THE LABORATORY.

With this issue begins the publication of a series of articles by George H. Rowe, associate professor of electrical engineering of Leland Stanford Jr. University, upon "Alternating Current Laboratory Testing," which, it is not doubted, will pass into the classics of theoretic investigation. No introduction thereto is necessary, otherwise than that it should be stated that the notes presented are the outcome of lectures delivered to students engaged in the experimental study of alternating current phenomena. They are intended to be used in connection with the books of Steinmetz, whose formulæ fit closely with the actual experimental results.

Believing that laboratory testing should lead—not to testing as a handicraft, but to a clearer conception of the relations between the expected and the real results—the author of them has usually prefaced each experiment with a brief discussion of the theory. This is followed by directions for taking the test—the most convenient log of results—and finally by the curve or other usual method of showing the result.

This presentation has been of use during fifteen years of the author's teaching experience, and it is now placed in more permanent form with the hope which is cherished that others may find in it some points of helpfulness.

IT'S WORTH A TRIAL.

In the efforts which engineers are exerting to strengthen and make permanent the link that is admittedly the weakest in the whole chain of transmission structure—the pole line—would it not be well for them to pause and consider whether the desire to attain the new has not led them to unduly depreciate the old?

Has transmission engineering done all that is possible for it to accomplish in the use of wooden poles? Great structures of steel are designed and erected on foundations that will defy the ages. Wood as a support for transmission lines appears to be going out of fashion, and the era that is being ushered in bespeaks the use of steel and concrete.

In the meantime what of the use of the treated wooden pole with butt embedded in concrete—the pole that, too, should withstand the ravages of reasonable time and the elements; that may be cheaper and, for aught we know, may be equally serviceable?

FOG BANKS AND FOG BREAKS.

That the limitation of permissable pressure usable in transmission lines is largely a question of meteorological conditions is emphasized in marked degree in the building of the seventy-mile system of the North Mountain Power Company, in Humboldt County, California, where there exists during days of every month of the year a fog bank so dense as to be all but of electro-invulnerability. It is interesting to watch the phenomena of the formation of this fog—perhaps better, this mist-bank. Humboldt Bay, whereon flourishes Eureka, the queen city of California's northern coast, is protected by a Government breakwater of broken rock that extends out some 7000 feet direct into the ocean. Here the rolling billows at once become terrific breakers, that, baffled, beat and boom in bellowing rage. Above them rises, as if in malediction, a spray that, widening and ever growing, drifts in shoreward until it covers the lowlands to the foothills and moistens a belt of country averaging a width of six miles by a length of above thirty miles. Snoqualmie, Washington's most noble cataract, in its feminine beauty, mothers a similar phenomena in the resolution of the spray arising from its great plunge, into a bridal veil of mist that floats airily down o'er the landscape in snowy purity as far as the eye can reach. Of this, however, have these columns spoken heretofore.*

To the transmission engineer and to the builder of exposed structural iron or steel work this Humboldt mist-fog is a terror, for its humidity is 91 per cent.—that is it carries moisture within 9 per cent. of the saturation point of air—and this moisture is the brine of the ocean. More dense fogs than this exist about Humboldt Bay in ordinary form, that is in the meeting of the warm land currents and the cooler ocean breezes, for these ordinary fogs have a recorded humidity of 98 per cent., but they are less corrosive than the mist-fogs, and they are less conductive, although both are equally harmful in their penchant for collecting dust, encrusting pins and insulators with mud, and in leading to their destruction under high tension service.

A further influence of this mist-fog is shown by the fact that on a summer's day the temperature at the top of the foothills that, crescent-like, encompass Humboldt

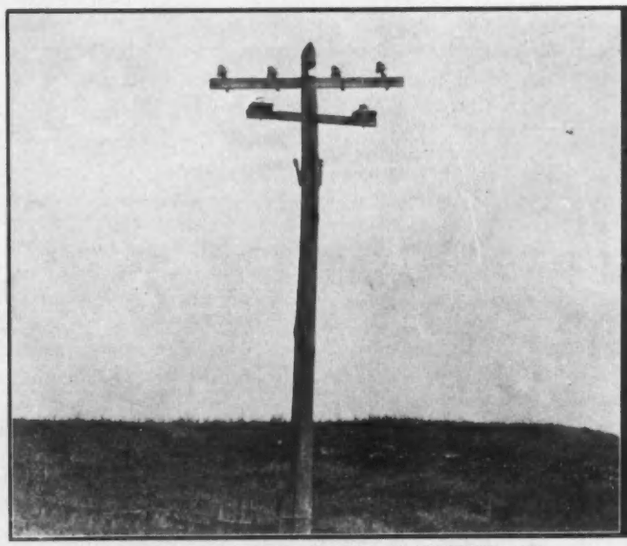
*THE JOURNAL, Volume XI, page 5, 1901.

Bay and its fog, will be, say, 94 per cent.; but in the forty minutes that it takes to drive down to practically sea level, the temperature will have dropped to its normal of 54 degrees.

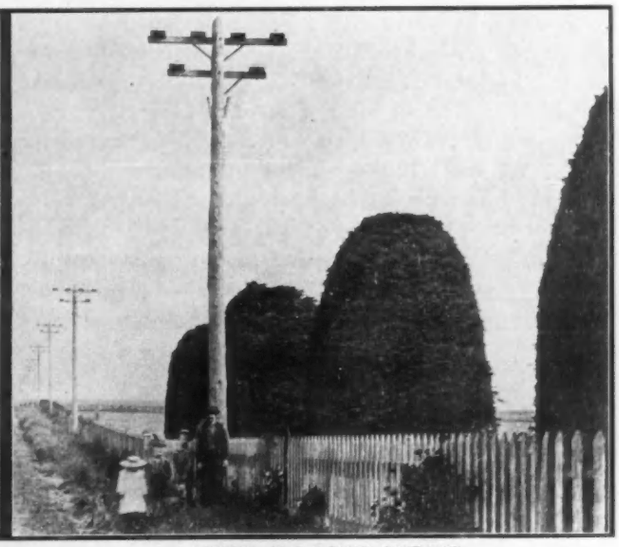
The North Mountain Power Company, which will begin operations early during the present month, will carry its main transmission line into Eureka at a pressure of 20,000 volts delta to a substation at the northerly outskirts of the city, where it will be reduced to 10,000 volts delta for local distribution through a southerly circuit reaching ten miles to Arcata, and through a second or northerly circuit reaching sixteen miles to Loleta. These 10,000-volt distribution circuits run parallel with and in the zone of the fog banks described, and the determination to use 10,000 volts as their limiting pressure was reached solely by reason of the conviction that the operation of 20,000-volt circuits would be attended by climatic conditions that would be well nigh insurmountable.

An instance that in a measure parallels the conditions confronting the North Mountain Power Company about Humboldt Bay is found in the 11,000-volt transmission line of the Big Creek Power Company of Santa Cruz, where the location of the original line along the very ocean beach for some fifteen miles of its length proved to be a matter of exceeding annoyance in the frequent shutdowns to the service that were caused by the fogs, sea spray and dust which settled on them and resulted in the frequent burning out of the insulators, pins, cross-arms, and even of the poles. In fact, it was not an infrequent occurrence after a heavy fog for four or five cross-arms to be burned out during a single night. It was this condition which led to the building of the Ben Lomond line that is placed well inland, far out of reach of the deleterious influences found on the coast. Nevertheless, in July, 1901, E. C. Lilly, of the Big Creek Power Company, devised and installed an ingenious method for preventing the accumulation of moisture and dust on the pin and insulator, and since the equipment of the exposed section of the line with a so-called fog-break box, the trouble has not recurred in a single instance. This device consists merely of V-shaped boxes built on the cross-arm, extending up towards the lower petticoat of the insulator. To be exact, in a cross-arm having a section of two and three-quarters by three and one-half inches, this box is nine inches in length by six inches in width by a depth of three inches above the upper surface of the cross-arm. It is made of one-inch redwood boards nailed together, and each insulator has a separate box. The principle upon which they were installed is merely that they afford an obstruction against which fog, spray and dust would beat instead of deing driven against the pins and insulators, over which it would sometimes form a coating of mud up to half an inch in thickness. The satisfaction which has resulted from the use of these insulator boxes has led to their adoption elsewhere, notably on the coast transmission lines of the United Electric, Gas and Power Company in southern California, now part of the system of The Edison Electric Company of Los Angeles, where three-phase current at 17,000 volts is being transmitted from Santa Monica to San Pedro and Long Beach, and where their use has proved equally successful as at Santa Cruz.

It is evident, then, that Santa Cruz has demonstrated the feasibility of fog boxes as a preventive for the evil, and that Santa Monica has given its endorsement to the testimony of Santa Cruz. The fog of Santa Monica is but condensed vapor—just plain fog—that of Santa Cruz is ocean mist with plain fog predominating; but Humboldt mist-fog is a notoriously bad character against which the experience of other localities may for the time be unavailing. If so, it may be well to remember that engineering ingenuity is resourceful, and that, to paraphrase, weak master though it be, even the mist-fog element will at last do its bidding.



A TYPICAL BURNED CROSS-ARM AND FOG PROTECTION BOX ON THE SANTA CRUZ LINE



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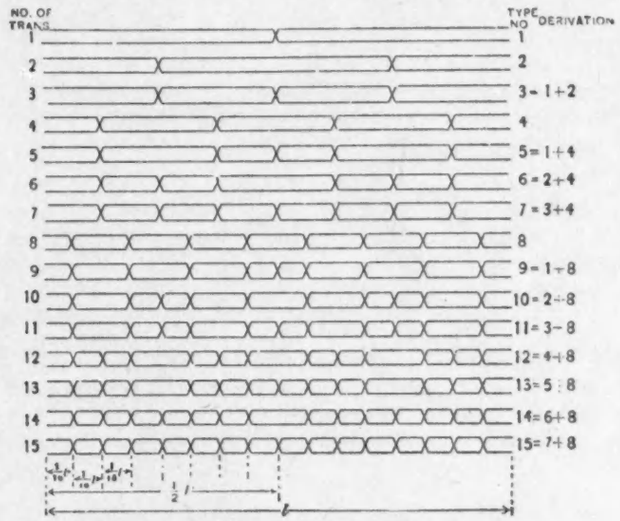

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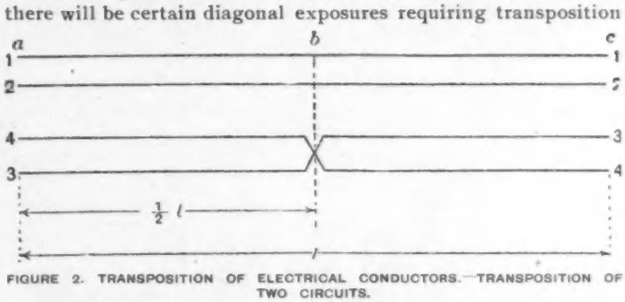

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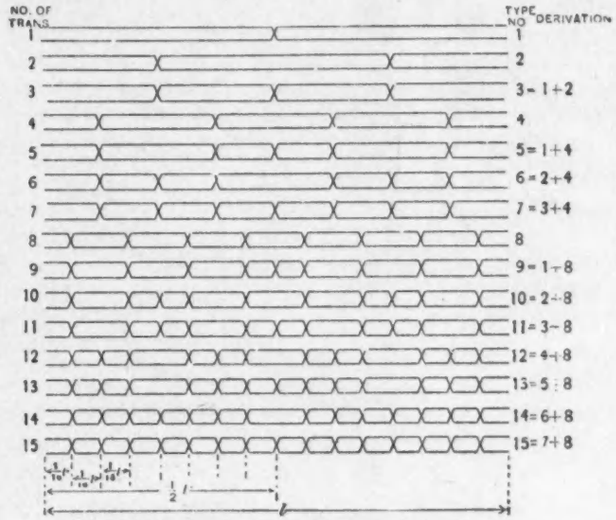

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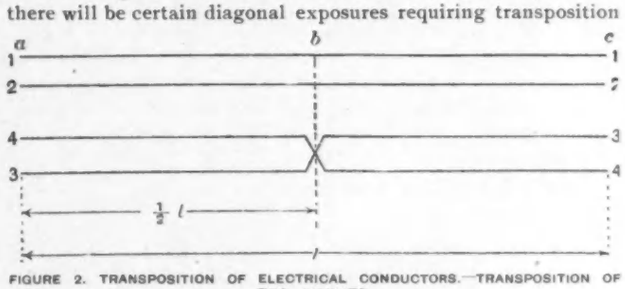

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When telephone lines are paralleled by power lines the transposition problem becomes more complicated. It is necessary to recognize the manner in which the disturbing circuits alter the magnitude of their influence, by reason of abrupt changes in line pressure or line current, and changes in the wire spacings. If circuit 1-2, in Figure 2, is the power circuit and 3-4 is the telephone circuit, there will be no mutual interferences if the distance 1 is not great. That is, the percentage pressure drop in 1-2 must be small enough so that the total induced charges on the portion *ab* are sensibly, equal and opposite to those on *bc*; likewise. the percentage current loss in 1-2 must be so small that the magnetically induced pressure in the portion *ab* is equal and opposite to that in *bc*. The question as to whether electric or magnetic induction is the greater is complicated by the radical differences between the systems. In long telephone lines the electric induction may predominate; the impedance of an indefinitely long line is usually several hundred or a thousand ohms, and therefore the pressure is very much greater in magnitude than the current. In power circuits this ratio is dependent largely on the load, in any given case, but there are many instances where the ratio of pressure to current is small. The magnetic induction is usually predominant to a large degree in the latter cases. There have been instances of exposure to circuits given twenty-four hour service, from which the induction was heavy only during the period of load.

In the circuit 1-2, in Figure 2, has connected to it a transformer or a branch circuit within *ac*, the effect of the transposition is no longer to neutralize the induction. If the transformer is at *b* the transposition will have the least effect. If 1-2 is a constant-current circuit and an arc lamp is cut in, the effect will be the same, as regards the efficiency of the transposition. A change in the spacing of the wires 1-2 will also decrease the effect of the transposition.

Therefore that portion of the disturbing line within which the conditions, affecting the phase or the magnitude of the induced currents and pressures, are constant should be treated as a section and all the telephone circuits should be transposed opposite its center. The regular cross-talk transpositions should be removed from the section. If the total external exposure to the power line involves several consecutive sections, the cross-talk transpositions should be opposite the junction of two sections, at the point where the disturbing current and pressure change in magnitude or phase.

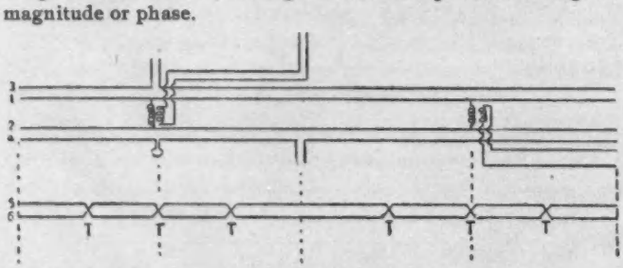


FIGURE 3. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—TELEPHONE LINES PARALLELING TRANSMISSION LINES.

The method shown in Figure 3 works well until the character of the exposure becomes complicated, and then the transpositions become so frequent as to be impracticable, and, further, they frequently cannot be properly situated because of physical limitations. If the electric light and power system is developing rapidly the exposures are changed frequently by new construction. Again, the telephone line may be separated from the power line by the width of a street; here the induction, while not excessive, is yet troublesome; and the theoretical transposition system to meet the conditions of exposure is just as elaborate as though one line were beneath the other. Twisted pairs or cable will meet this condition, although either remedy impairs the telephonic line efficiency. A prior consideration is whether the power wires are not separated, with respect to each other, farther than is necessary with the pressure employed, and whether the separations are uniform.

Where telephone lines have paralleled transmission lines along highways, separated by fifteen or twenty feet, or by the width of the highway, the following practice has been employed: All the telephone circuits are transposed at every tenth pole, the cross-talk transpositions occurring midway, so that transposition poles are five spans apart, the cross-talk and the induction transposition poles alternating. This practice, while it is somewhat uncertiain of producing the best results, is probably best suited to certain requirements—where the method of sections would not produce any better results because of the physical unevenness and crookedness of the right of way.

Not infrequently high-pressure systems are transposed for their internal protection. When telephone circuits are on such pole lines, the transpositions in the power circuit may be availed of to reduce induction in the telephone circuits, but in the case of separate telephone circuits, on a parallel pole line of separate

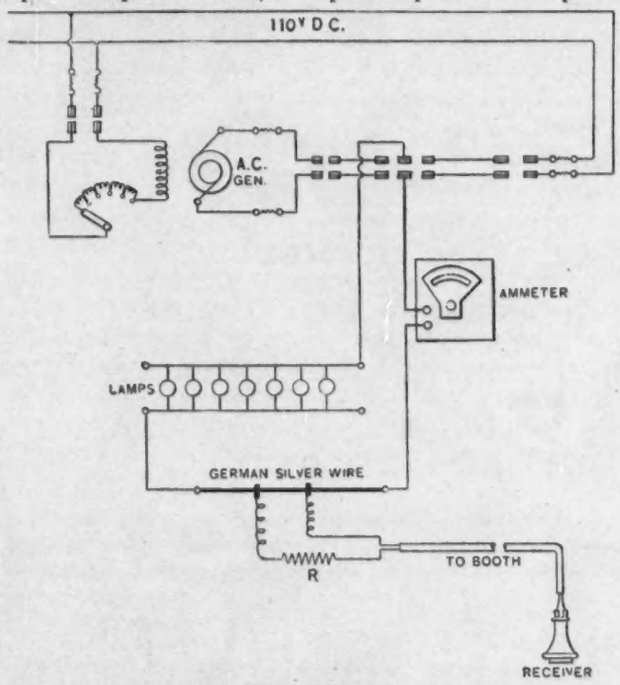


FIGURE 4. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—APPARATUS FOR DETERMINING PERMISSIBLE FREQUENCIES.

ownership, it seems wiser to treat such transpositions as neutral points—to be opposite the junction of two transposition sections of the telephone line. The question of where to locate telephone wires on high pressure lines and how to protect them contains material for a paper by itself. In general, the induction from a three-phase line is slightly greater than from a single-phase line having the same wire spacing and current per wire and a pressure equal to the △ pressure. The separation between the wires should be as small as consistent with the length of span, and their plane suitably arranged with respect to the plane or planes of the power circuits.

A three-wire, three-phase line will have two transpositions within a section. It seems to be fairly general practice to transpose high pressure systems, but it has been the writer's observation that the length of a section is usually three miles at least. On that account it is difficult to avail of the power line transpositions in transposing the telephone line, and it is usually necessary to treat them at the junction points between adjacent sections.

On account of the very low frequency and the high ratio of pressure to current customary in high pressure practice, there are usually no inductive interferences if the power and the telephone lines are separated by the width of a highway, or thirty to forty feet, because the regular cross-talk transpositions are sufficient.

In the case of a single telephone circuit parallelling a power circuit, the frequency of transpositions is a problem requiring

calculation in any given case, because of the lack of standard practice in regard to wire spacing and circuit location. The writer made a series of listening tests with a bipolar receiver of seventy ohms resistance, to determine the permissible current at low frequencies which would not interfere with telephonic transmission over the longest lines—1000 miles and upward. The circuit is shown in Figure 4.

The method was that of deriving a very small known pressure from a non-inductive resistance and inserting a very large non-inductive resistance R (1000 to 20,000 ohms) in series with the shunt circuit containing the receiver. The listening tests were made by four observers, who adjusted R to the minimum permissible value, in their estimation. The average results are plotted in Figure 5.

Naturally, these results based on ear measurements are not highly precise, but they represent very small disturbances and are safe practice. In the case of short telephone circuits on power lines, used for private purposes, the receiver power may be much reduced and the permissible terminal current greatly increased.

There are two types of construction in use in making transpositions. One of these, the old-fashioned square transposition made by dead-ending both wires, each way, on two-piece insulators, and cross-connecting, is familiar to all. The other method requires two spans in which to complete the entire transposition. It is known as the "Murphy" and "single-pin" transposition, and is coming into general use.

It has the comparative advantages of less first cost and simpler construction. It can be cut in at any time, cut out or moved several poles, at less cost and with much less work than in the

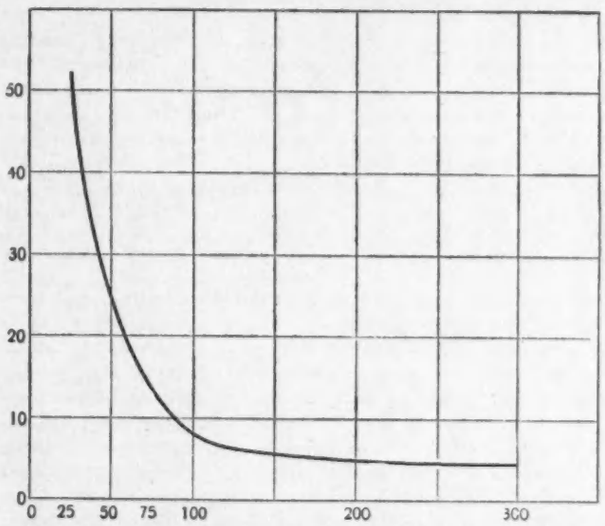


FIGURE 5. TRANSPOSITION OF ELECTRICAL CONDUCTORS.—AVERAGE RESULTS OF LISTENING TESTS.

case of a square transposition. If transpositions occur frequently, every one-fourth or one-half mile, the line capacity is increased a few per cent. and the line inductance diminished, with a consequent slight increase in attenuation. The square transposition has the advantage of concentrating the entire transposition within a very short length and of not altering the plane or the separation of the wires. While the single-pin transposition changes the plane of the circuit, the wire separation is greatly reduced, and this is an advantage. Since it requires two spans in which to make this transposition, it is possible to transpose only at every other pole, as a maximum, in case of excessive induction, against every other pole for the square induction. For regular cross-talk connections the single-pin type is now preferred.

In conclusion, it seems evident that the recommendation of standards in the matter of wire separations, standard cross-arms and standard systems of transmission, would greatly facilitate the removal of inductive interferences and materially assist the builders of telephone circuits throughout the country.

OBITUARY.

MR. AXEL GUTSCH, so long prominent in the gas industry of California, died very unexpectedly at his home in Alameda, on Monday, December fifth last, from an acute attack of dropsy. A brother, Mr. Gustav Gutsch, an attorney of San Francisco, alone survives him, and in addition to him, those who mourn encompass each and every one of the deceased's business and social acquaintances to a man.

Mr. Gutsch was born in Germany in 1863, where his education was finished at the Naval University of Potsdam. Soon thereafter he entered the German army in which he attained a lieutenantcy, but in the early '80s he came to this country, settling in Texas, where he remained for several years before coming to California. His first entry into the lighting field occured in 1891, at which time he was identified with the California Wine Association of Fresno. In 1890 Mr. Robert G. Barton, of the Barton Vineyeard Company and the California Wine Association, built the Barton Opera House in Fresno, to illuminate which an isolated electric lighting plant was installed. This installation, which was an Edison three-wire plant, proved to be the neucleus of the Edison Electric Light and Power Company of Fresno, of which Mr. Gutsch was appointed general manager at the time of its incorporation in 1891. A bitter warfare followed with the old company—The Fresno Gas and Electric Light Company—which resulted in the absorption of the Edison interests by the gas and electric light company in 1893, whereupon Mr. Gutsch was elected secretary and general manager of the surviving company.

"It was during this time," said Mr. Gutsch to the writer some months ago, "that freight on Santa Paula oil was $132.00 per carload from the Santa Paula fields to Fresno, while the freight on the same car of oil to San Francisco was but $62.00. The cost of coal was all but prohibitive, as it ran as high as $12.00 per ton of Cardiff and $4.90 to be added for freight from San Francisco to Fresno—in fact the records of the company show that during the four years from 1889 to 1892 inclusive, the Fresno Gas and Electric Light Company paid the Southern Pacific Company for freight on coal the very sizeable sum of $37,612.76, or nearly $800.00 per month. These figures show why the advent of electrically transmitted power made the successful operation of a steam-driven plant an impossibility in Fresno, and they also show why the price of $18.00 per month imposed for the twenty-four street arc lamps operated from the steam plant was not extortionate, regardless of the prices prevailing in other localities."

In April, 1897, the San Joaquin Electric Company begun the operation of its transmission line into Fresno, prices were cut to as low as 10 cents per 16 candle-power lamp per month and to $6.40 per 2000 candle-power arc lamp per month—prices which the old company could not hope to meet—so that after a five months' war the gas company relinquished the electric lighting field to the transmission company. Then a year later, when Mr. Gutsch was again secretary and manager of the gas company (he had resigned in the meantime to take up similar duties elsewhere, as will be related), the San Joaquin Electric Company was forced into the hands of a receiver by reason of Mr. Gutsch's active campaign as manager of the gas company.

After his first period of service at Fresno, Mr. Gutsch was sent to Tucson, Ariz., to install a competitive gas plant in behalf of the Pacific Lighting Company of San Francisco, but his labors there were terminated after a few months by the acquisition of the interests which he represented by the old company. Thereupon he returned to San Francisco, when the Pacific Lighting Company, realizing the value of his generalship on battlefields of lighting warfare, sent him to Santa Rosa to marshal the forces of the Santa Rosa Lighting Company against The Merchants' Lighting Company of Santa Rosa. This was in February, 1896. He did not remain there long, however, for it became necessary for him to return to Fresno. In the meantime the property of the Santa Rosa Lighting Company had been leased to a party who failed in July, 1900, whereupon it reverted to its owners, the Pacific Lighting Company, who again placed it under the management of Mr. Gutsch, where it remained almost until the

acquisition of both the Santa Rosa Lighting Company and The Merchants' Lighting Company by the California Central Gas and Electric Company in August, 1901.

It was not long thereafter that Mr. Gutsch established himself in a most succestful business as a broker in gas appliances, wherein he was engaged at the time of his death. He was an active, honored and progressive member of the gas fraternity, and above all in him there was ever found the benefaction of good fellowship, the boon of loyalty and the soul of integrity. Most fittingly, then, has one of his late business associates, Mr. George M. Clark, issued the tender announcement that "In the death of Mr. Gutsch we have lost one of our most valued men. For five years he has faithfully served our interests, and we take this means of paying our respect to his memory as a man distinguished for a fine sense of honor, strict regard for his obligations and consideration for the rights and feelings of others."

THE LAY PRESS.

OIL-PIPE LINES AS COMMON CARRIES.

CALIFORNIA petroleum producers will watch with intense interest the experiment which the Kansas Legislature is about to make for the regulation of oil transportation in that State. At a conference of some of the members held at Topeka this week the conclusion was reached that oil-pipe lines may be legitmately classed as common carriers, and a bill is to be introduced during the coming legislative session declaring them to be such. It is assumed that legislation of this kind will be strictly constitutional, and if the bill becomes law, its operation will be of immense benefit to the oil-producing and oil-refining industries.

The object of the measure is to destroy the Standard Oil Company's monopoly of these industries in Kansas, which that corporation is doing there, as it is attempting to do in the Kern county oil fields, through the agency of its pipe-lines and combinations with the railroads. If the oil-pipe lines can be legally declared to be common carriers, they can be required to transport and deliver the product of any oil well at any refinery designated by the shipper at reasonable rates. Moreover, these pipe-lines can then be brought under the control of the State Transportation Commission, and their rates regulated in the same way that railroads fares and freights are regulated.

The Kansas proposition is something quite new, and if sound in law, as it appears to be in principle, its success will be a matter of intense interest to all oil districts in California which are dependent, partially or wholly, on pipe-lines for the delivery of their products at tidewater. The pipe-line recently put in operation between the Coalinga district and Monterey is, we understand, acting as a common carrier now. It was in fact, constructed as such. And certoinly every other oil-pipe line laid in the State has availed itself of many of the privileges commonly enjoyed by such semi-public corporations as are admittedly common carriers. If the Kansas plan of forcing the Standard Oil Company's pipelines in that State to perform the functions of common carriers succeeds, it ought to be possible to apply the procese to the corporation's pipe-lines in this State. That would probably solve the problem confronting the independent oil reducers and refineries who are now suffering from the monopoly created by the Standard Oil Company and its confederated corporations.—*San Francisco Chronicle*, December 2, 1904.

A CONTRACT AWARDED.

The Washington Water Power Company has awarded the contract for two type "B" water wheels of 3300 horsepower each and all the piping into the forebay for its plant at Post Falls, Idaho. The wheels will run 138 revolutions per minute and will be direct connected to General Electric generators of 2250 kilowatts each. The gates will be controlled by type "M" Lombard governors. The plant has been designed to accomodate six units of 3300 horsepower each.

PERSONAL.

Mr. David B. Rushmore, electrical engineer of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., spent a fortnight during the past month in examining the principal transmission systems of California.

Mr. William Knight has resigned his position in the sales department of the Brooks-Follis Electric Corporation to accept a similar position with John A. Roeblings Sons Company, taking in Lower California, Arizona and a portion of Mexico.

Mr. E. B. Parsons, who has been engaged in the sales department of the Westinghouse Electric and Manufacturing Company San Francisco branch, has accepted the position as salesman in charge of the machinery department of the Kilbourne & Clark Company, San Francisco office,

Mr. David W. Coons formerly president of the Los Angeles Electrical Specialty Company, has disposed of his interest in that company and will engage in the general electrical supply business in St. Louis. He will be located with the Katharmon Chemical Company, 101 North Main Street, St. Louis.

Mr. C. W. Whitney has resigned his position as Pacific Coast representative of the McGraw Publishing Company, New York, and has become identified with the Abner Doble Company of San Francisco, engineers and manufacturers of tangential water wheels and needle regulating nozzles. Mr. Whitney will have charge of the Abner Doble Company's publicity department.

Dr. Louis Duncan, who is known throughout the scientific world for his attainments in electrical work, is another of the prominent men who have become associoted with the staff of the Allis-Chalmers Company, of Milwaukee. Dr. Duncan has been retained by the Allis-Chalmers Company as an expert in electrical patent work in connection with its electrical department—The Bullock Electrical Manufacturing Company, of Cincinnati. This connection has only recently been made possible by the retirement of Dr. Duncan from the chair of electrical engineering at the Massachusetts Institute of Technology, to which he was appointed in 1892. Dr. Duncan will continue to make his headquarters in New York at 46 Pine Street, where he will be closely in touch with the legal and executive offices of the Allis-Chalmers Company.

Harris J. Ryan, professor of electrical engineering at Cornell University, has been appointed head of the electrical engineering department of Leland Stanford University, vice Professor George H. Rowe, resigned. Since the resignation of Dr. F. A. C. Perrine some years ago, the electrical engineering department has been under the supervision of A. W. Smith, head of mechanical engineering, and later of W. F. Durand, who came from Cornell, and under whose direction Professor Rowe has so ably carried out the work allotted to the electrical engineering department. The latter's successor, Professor Ryan, who is hardly 40 years of age, graduated from Cornell about 1885, and spent some time in practical engineering work in the middle West. Then he was called back to Cornell, first as instructor in physics and later, in 1889, he was appointed assistant professor of electrical engineering. For the past seven years he has held a full professorship. During extended leaves of absence he has engaged frequently in practical work, and has made several trips of inspection, both in this country and abroad. He holds high rank as an investigator, among his discoveries being some which will give him an enduring place in the history of the development of electrical engineering. He is the author of several electrical inventions, and has written a large number of professional papers dealing with various phases of electrical engineering.

Electric Station A of the Eureka Lighting Company burned on the afternoon of December 13th, entailing a total loss on the building and material damage to its machinery. Insurance, $20,500.00; cause, probably electrolysis of railway generater leads in damp vault under station.

INDUSTRIAL

A NEW LINE OF WESTERN ELECTRIC MOTORS.

THE Western Electric Company is now placing on the market a new line of direct current motors and generators ranging from one-half to sixty horsepower output. By referring to Figure 1 (the open type) it will be noticed that the frames are of the bracket bearing type. By placing solid covers over the openings in the bearing end plates the motors may be made dust

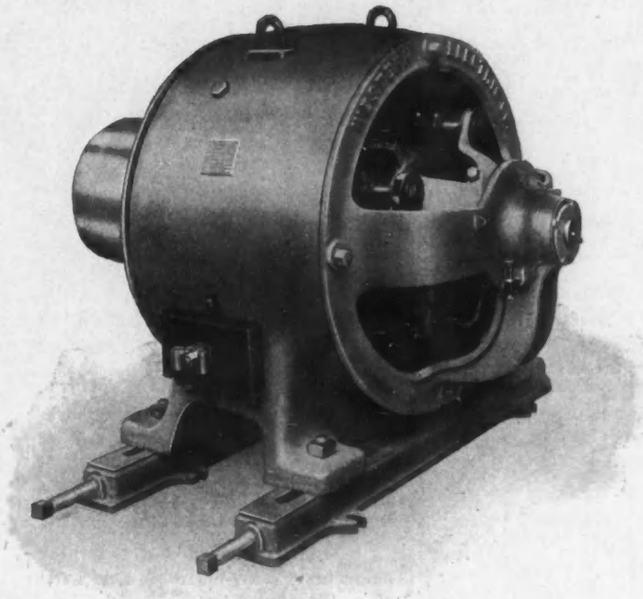


FIGURE 1, TYPE "E."

proof. A perforated grid may also be used, giving the machines mechanical protection and at the same time allowing easy ventilation. A motor of this type is shown in Figure 2.

The mechanical design has been given great attention. The bearings and shaft are liberally proportioned and will be found well adapted to the hard service for which the machines are intended. The bearings consist of a cast iron journal box, babbitted, the outside of the box being turned to fit its seat in the bearing bracket accurately. The yokes are all cast iron, each frame is bored at the ends to receive the bearing brackets, each held in place by four cap screws, by loosening these screws the bearing brackets may be rotated to their proper position when it is desired to place the motors on the wall or ceiling. All of this new type are of the four-pole design, the pole pieces being laminated and having projecting tips holding the field coils in place.

The armature laminations are built directly on the shaft, having heavy cast iron end plates, which hold them in a fixed position. The armatures on all but the small sizes are provided with radial ventilating ducts, as well as ventilating ducts through the center parallel to the shaft. The armature coils are of the form wound type, thoroughly insulated seperately and together before being placed on the armature cores. On the larger machines the coils are retained in position by fiber wedges, while in the smaller sizes band wires are used.

Great care has been taken in the commutator design. The materials used and the construction are such as to obtain commutators in which mica and copper shall wear together and prevent the frequent cause of sparking and trouble—high mica. In the smaller machines the conductor is soldered directly into the end of the commutator bar, while in the larger sizes commutator tangs are used.

Particular attention is called to the brush holders on these machines. All machines are provided with rocker arms so that the brushes may be adjusted to secure the best operating position. In the smaller sizes the brush holder is of the pocket type, the carbon being pressed against the commutator by a flexible finger. The carbon is provided with a pig tail which carries the current entirely aside from any sliding contact. The details will be seen by referring to Figure 3. In the four larger frames a different type of holder is used, shown in Figure 4. The carbon is held in fixed contact with the front edge of the holder, no reliance being placed on sliding contacts for carrying the current. The parallel springs are not used to provide pressure in causing the brush to bear against the commutator, but

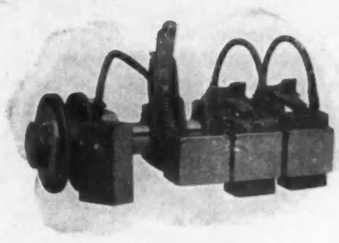


FIGURE 3.

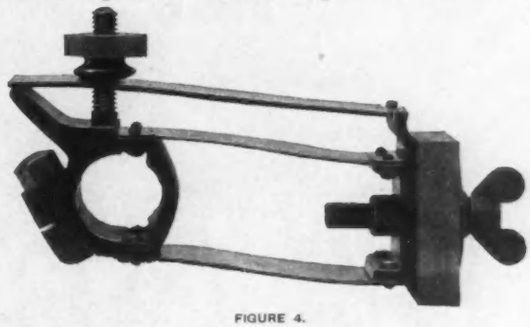
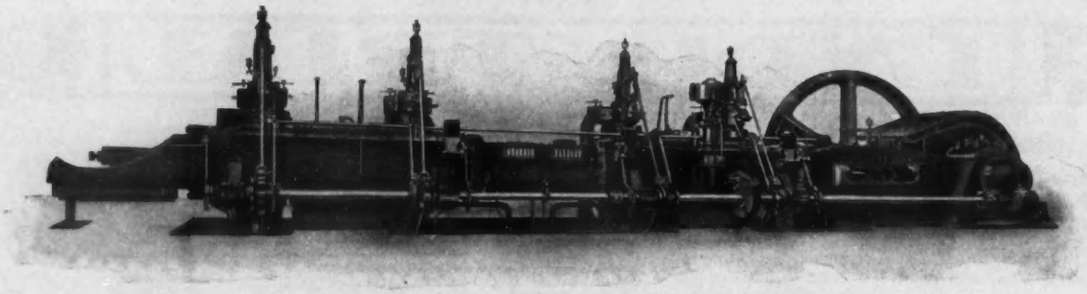


FIGURE 4.

this is taken care of by the spring at the upper side. It will be noticed that in both these types of brush holders the moving parts are very light, In the holder used for the smaller machines there

FIGURE 2. TYPE "C"

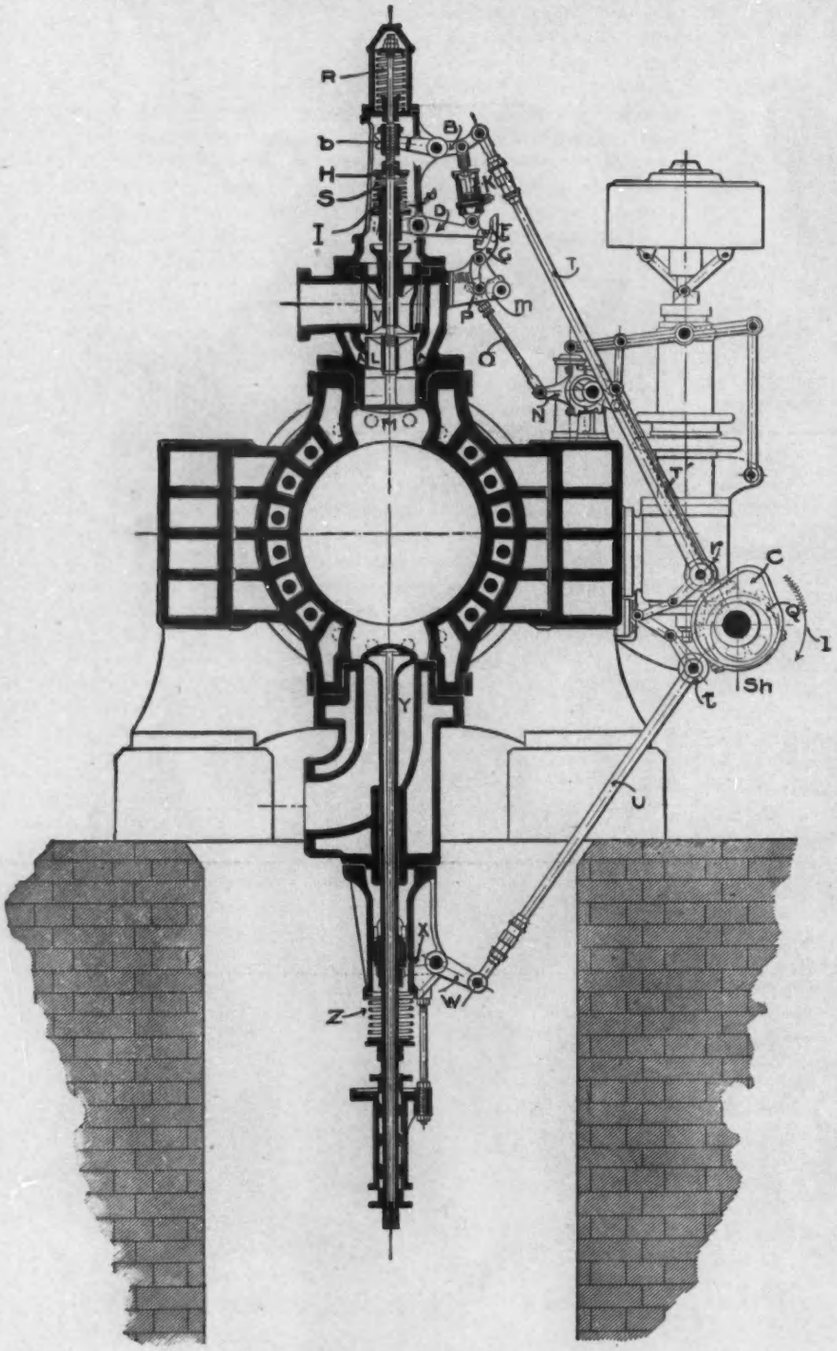


FIVE HUNDRED HORSEPOWER TANDEM DOUBLE ACTING COCKERILL GAS ENGINE

being nothing movable but the brush and the pressure spring. The brushes in both types move in perfectly parallel lines, maintaining the even and true contact between brush and commutator throughout the life of the brush. The requirements of the Standardization Committee of the American Institute of Electrical Engineers with regard to insulation resistance, break-down tests, and temperature of all parts, have been complied with in all cases.

A full line of accessories, such as automatic belt tightening device, ceiling or wall carriage, slide rails and back gear attachment are carried.

The California Electrical Works, 547 Mission Street, San Francisco, Pacific Coast agents of the Western Electric Company, have just received a large shipment of these new type machines.



VALVE GEAR OF THE COCKERILL GAS ENGINE

SOME IMPORTANT FEATURES OF THE COCKERILL GAS ENGINE.

NOW that California enterprises have entered upon the exploitation of gas engines in large units for the development of power along a scale that is all but of unprecedented magnitude, it is of importance to note several important features that have been adopted in the construction of one of the foremost of American built gas engines—the Cockerill gas engine as manufactured by The Wellman-Seaver-Morgan Company, of Cleveland, Ohio. The design of the cylinders in the Cockerill engine presents the following important features:

Owing to the considerable differences in temperature occuring in the cylinder, it is necessary to provide for free expansion, and this is obtained by supporting the cylinder in a cradle, one end only being attached to the main girders of the engine bed. The power of each end of the cylinder is transmitted directly through the girders to the engine frame, as the two heads of each cylinder are connected by through-going bolts, and the power developed in the back end of the cylinder is transmitted through these to the front end. The cylinder proper is therefore not subjected to the stresses incidental to power transmission.

The pistons are steel castings in one piece and secured to the piston rod by means of a collar and nut No taper is used on the rod, and the wedge action caused by tightening the nut, and thereby tending to split the piston, is avoided. A special feature of our engine is the water cooled piston rod nut, which is an additional preventive to premature ignition. The pistons do not bear in the cylinders, but are supported outside the cylinders by cross-heads.

All valves of each cylinder end are operated by a single cam; therefore in a four cylinder double acting gas engine there are only eight (8) cams in all. The valve gear though performing the regulation of the mixture in a perfect manner, is of the greatest simplicity, and consists of only a very few parts in motion. The side shaft *SH.* driven

by the engine shaft, making one revolution to two of the latter, because of the four cycle principle, carries a cam *C* for each cylinder end. This cam serves for operating both the inlet and outlet valves. The cam revolves in the direction indicated by the arrow *l*. When the lobe of the cam begins to act on the roller *r*, the latter and the rod *T* rise, the lever *B* oscillates and its end *b* decends. This movement causes both the mixing valve *M* and air valve *L* to open. The latter, which is fixed to the mixing valve *M*, uncovers the air ports *A*. The moment of opening these valves correspond exactly to the dead center position of the piston at the beginning of the suction stroke. In the first part of the suction stroke air only is therefore drawn in. The double beat gas valve *V*, concentric with the mixing valve, remains closed. It is operated by the lever *D*, whose outer end *E* engages with the latch *F* of the lever *G*, when the inlet valves are on their seats. During the opening of the mixing valve, the spring cap *H*, fastened to the mixing valve stem, compresses the spring *S*, as the spring cap *I* on the other end is fastened to the hollow stem of the gas valve, which being blocked by the latch, remains closed. The connection *K*, and its parts, act as a link of variable length between the levers *B* and *D*.

An eccentric *Q* on the side shaft *SH* operates a small cam *m* by means of the rod *T*, the oscillating lever *N* and the rod *O*. The center of oscillation of lever *N* is variable and under the control of the governor, and the effect of the displacement of this center is similar to a change of the length of the rod *O*. The cam *m* operating on the roller *P*, secured to the end of the lever *G* disengages the latch *F* at a definite moment predetermined by the governor, and the gas valve *V* opens quickly, the amount of opening being limited by the space between the piston and the bottom of the dash pot cylinder *K*. The proportions of the lever *B* and *D* are such that the opening of the valves *V* and *M* and also the slide *L*, bear a fixed relation with one another. From the moment of the opening of the gas valve, which corresponds to a certain predetermined position of the piston during the suction stroke, air and gas in proper proportions are admitted so as to give a good mixture. Whatever, therefore, the moment of cut off may be, the proper quantity of gas and air for a good mixture is admitted. The two valves and the slide remain open until the end of the suction stroke. At this moment while the roller *r* decends on the lobe of cam *C*, the larger spring *R* closes the mixing valve and the air slide, and the link *K* returning to its original length transmits the descending motion of *B* to *D*, and closes the gas valve *V*. The small spring *S* is introduced so as to permit the mixing valve *M* to continue its motion and seat itself should the valve *V* touch its seat before *M* can close. The piston on its return stroke compresses the charge, the inlet and outlet ports of the cylinder being closed; but as the variable quantity of mixture followed a certain volume of air aud completed the 100 per cent. of cylinder volume, the best mixture remains close to the igniters located in each cylinder head, and therefore firing is assured even with smallest load.

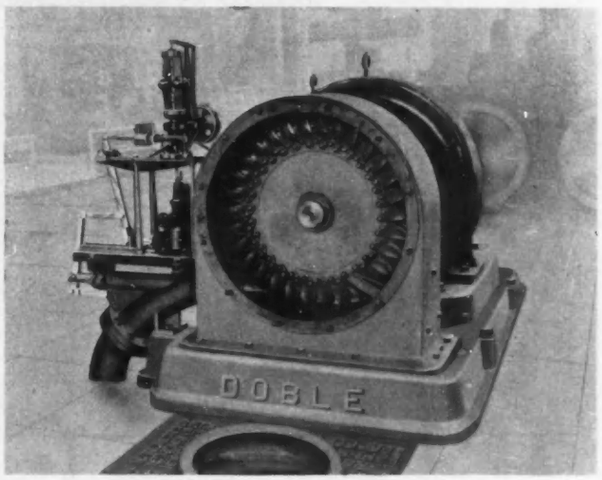
A little before the dead center corresponding to the end of the expansion stroke, the lobe of the cam *C* touches the roller *t* and acts by means of the rod *U* and the levers *W* and *X* upon the exhaust valve *Y*, opening the same. This valve remains open during the exhaust stroke (second return stroke of the piston), and is closed on the dead center corresponding with the beginning of the next suction stroke by means of the spring *Z*, which acts at all times to close the valve and presses the roller *t* against the cam *C*.

DOBLE WATER-WHEEL EXHIBIT AT ST. LOUIS WORLD'S FAIR.

CONSIDERABLE interest attaches to the Grand Prize, the highest award given at the St. Louis World's Fair, which was awarded the Abner Doble Company of San Francisco, by the International Jury of Awards. This was not only the highest award given by the Exposition but it was also the only grand prize awarded to a machinery manufacturer west of St. Louis. It therefore speaks well for the excellence of engineering design and the high-class workmanship of the machines manufactured by this long-established San Francisco firm. Incidentally it also brings honor to the entire Pacific Coast.

The exhibit for which the grand prize was awarded consisted of the 170-horsepower Doble tangential water wheel ahown in the accompanying illustration. The wheel was displayed as an operating exhibit, the details of its installation being carried out in a thoroughly scientific manner. The successful working of the water wheel unit from the time of its installation until the closing day, formed one of the most interesting as well as most instructive features in Machinery Hall.

The hydro-electric unit was an excellent illustration of the manner in which electricity is generated in high-head water power plants on the Pacific Coast and elsewhere and in fact was a typical water power plant in itself. As no natural high head of water was available at St. Louis, the water, under the hydraulic pressure to show the plant in operation, had to be furnished by other means. To meet this condition there was installed a duplex triple-expansion condensing mine pump with a capacity of 1200 gallons per minute. This high-lift pump operated against a head of 700 feet, and supplied water under the 300 pounds pressure for which the water-wheel was designed. In this connection, it is interesting to note that this was the first time that a water wheel has been shown in actual operation and doing useful work at a World's Exposition.



DOBLE WATER WHEEL UNIT AT THE ST. LOUIS EXPOSITION

To fully carry out the operating feature of the exhibit, the water wheel was directly connected to a 100-kilawott, railway-type generator, furnished direct current at 550-volts to the feeder system of the Intramural Railway power plant. The operating speed of the unit was 700 revolutions per minute.

The hydro-electric unit was of the two-bearing type, the water wheel being mounted on the extended shaft of the generator. This two-bearing type of construction originated with the Abner Doble Company and has now been generally adopted in modern water power plants.

Following the regular practice of the Abner Doble Company, great care was exercised in the engineering design, in the selection of materials and in the workmanship, the result being the production of a water-wheel that is fully as efficient and durable as the larger machines manufactured by the company. The wheel was of particular value as an exhibit as it was of the standard construction of the Abner Doble Company, being built in all its parts, except the plate-glass sides of the housing, for practical and commercial operation. It was equipped with Doble patented ellipsoidal buckets, made of selected gun-metal castings. Each bucket was machined to an accurate fit and fastened to the rim by two fitted bolts in reamed holes. These buckets, as in all Doble water-wheels, were interchangeable and were brought to the same weight so that the wheel was dynamically balanced. The

hydraulic surfaces of the buckets were carefully ground smooth and polished, and the dividing wedge and entrance edges were accurately machined and sharpened.

The stream of water used to drive the water wheel under the 700-foot head issued from and was controlled by a Doble patented needle regulating nozzle, actuated by a governor. This type of nozzle, which has been developed by the Abner Doble Company to a high state of perfection, has the advantage of permitting close regulation of speed and maintaining a high efficiency of the jet over a wide range. The regulating is done by moving a core piece axially within the nozzle, thereby changing the annular area of the orifice. An efficiency of 99.3 per cent. has been obtained in recent investigations of this form of nozzle at the Massachusetts Institute of Technology.

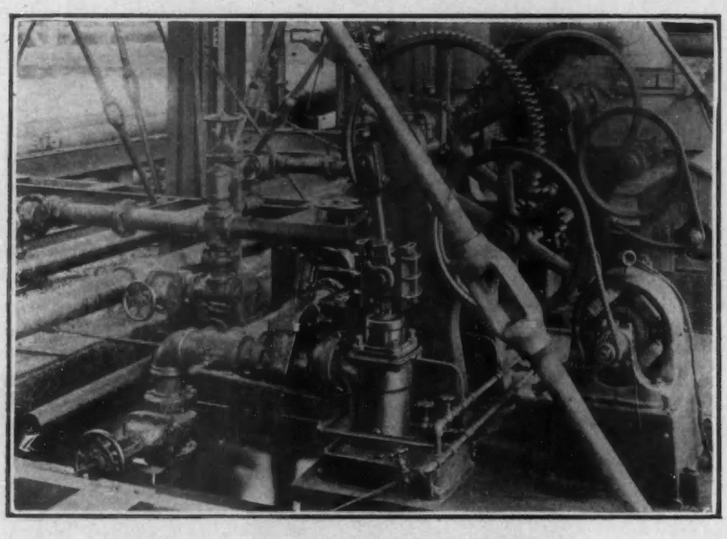


FIGURE 1. GAS TAR PUMPS OF THE MARYLAND STEEL COMPANY

In order that the action of the water on the buckets, as well as the perfect form of the jet issuing from the needle nozzle, might be observed at all times, the sides of the water-wheel housing were constructed of plate glass.

The quantity of water delivered to the wheel was measured by means of a meter equipped with recording register and manometer, while a recording pressure gauge was used to register the pressure of the water including the losses in the nozzle and its connection to the meter. The speed was indicated by a shaft tachometer and the electrical output was registered by the switchboard instruments of the Intramural power plant. It is evident that these measurements were of value in demonstrating the high efficiency of the tangential water wheel.

PUMPING TAR AND OTHER HEAVY LIQUIDS.

IN many industries it is necessary to force heavy, viscous liquids through pipes. This involves difficulties not encountered in ordinary pumping, and requires machinery special in design and construction. When the liquid is heavy but not adhesive, as in the case of heavy oils, the action can be made fairly satisfactory and efficient by enlarging the valve openings, making the parts of the pump heavier and so arranging the passages of the pump that there is little liability of choking or clogging. When, however, the liquid is a fluid at high temperatures and a gelatinous adhesive paste or a rubbery solid, clinging to all surfaces and choking openings through which it should pass, as the temperature is lowered, a design differing materially from the ordinary pump must be used.

Tar, molasses and cocoa liquor present more obstacles to pumping than any other substances which it has been found feasible to move in this manner. Each of these liquids thickens into an almost solid mass when cold, rendering it very difficult to start the pump, if some special provision is not made and ample power provided. Another action which must be taken into account is the contraction of the area of the passages and valves as the liquid cools and the consequent throttling which interferes with the liquid's passage and which the pump is forced to overcome. The skin friction of a liquid of this kind creates heat enough to partially alleviate this tendency to throttling when the velocity of the substance is maintained above a certain point and the pipe is not in such a position that the surrounding air will lower the temperature of the liquid below the solidifying point. Although not a common practice, it is well to lag all exposed piping used for conveying heavy oils or other substances of a similar nature.

Gas tar has a number of characteristics rendering it exceptionally difficult to pump. Its condition varies from a solid to a penetrating fluid within a small range of temperature. Two pumps which have proved very efficient in lifting and forcing gas tar were installed a short time ago at the plant of the Maryland Steel Company, of Sparrows Point, Md. Figure 1 shows the pumps in position, the one in the foreground being idle and the one in the background working under its normal load. They were built by the Deane Steam Pump Company, of Holyoke, Mass., and are of the standard triplex type of that company, fitted with ball valves peculiarly adapted to this service. The exclusive use of gate valves in the piping system is also interesting. A very flexible power connection is obtained by the use of the Renolds silent chain and a four-pole alternating-current three horsepower motor. The gearing consists of an eighteen tooth pinion running at 950 revolutions per minute and a 120-tooth wheel running at 142 revo-

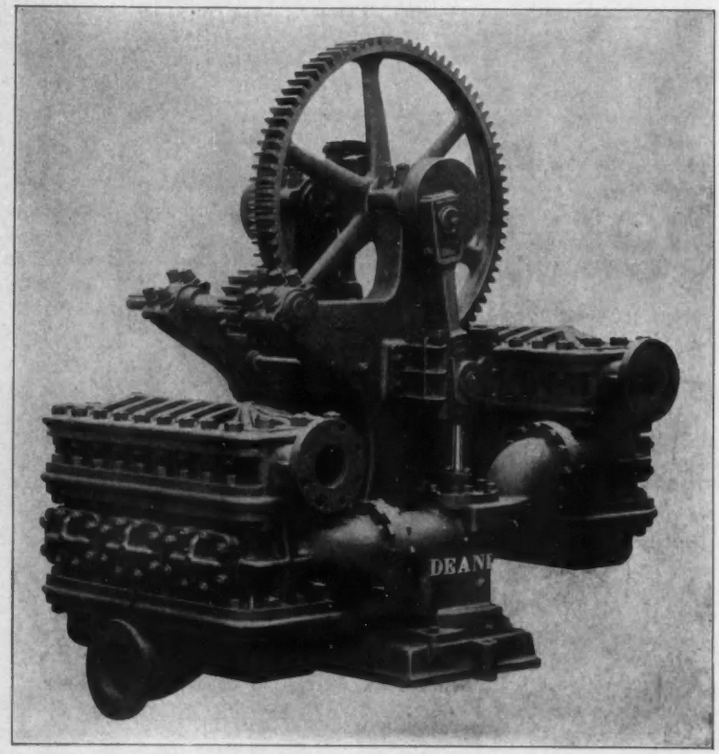


FIGURE 2. OIL REFINERY TAR PUMP OF THE ATLANTIC REFINERY COMPANY

lutions per minute. The chain used has links three-fourths of an inch wide and one and one-half inches long. It transmits the three horsepower generated at 950 feet per minute, giving an excellent efficiency when the service is considered.

A liquid peculiarly difficult to handle is oil-refinery tar, which is usually very hot when it reaches the pump. There is a large percentage of suspended particles of various sizes present in this tar and also a certain amount of unrefined paraffin. The tar is sometimes heated to a temperature of 300 degrees; but quickly cools off if not properly handled, and coats the retaining valves and walls with layers of an adhesive substance closely resembling finely divided particles of coke. To overcome these difficulties the ordinary pump arrangement and design is materially changed.

Figure 2 shows a specially designed pump installed by the Dean Company for handling oil-refinery tar at the works of the Atlantic Refining Company, in Philadelphia. By a new arrangement, exceptionally large valve areas are made available, the valves being designed to permit the passage of the substance pumped with the least possible frictional resistance. The suction, discharge and pulsation chambers can be taken apart without unnecessary expenditure of time or labor, and each is in a position where it can be readily reached for cleaning. The pump is of the triplex type, as shown in the figure, and is fitted with ball valves, which thorough test has proved best adapted for the passage of heavy substances. There are a number of large hand holes for cleaning the valves. The figure shows the rigid cross-head guide system and the strong design of the chambers, rods, pistons and bearings.

Machinery which will pump these adhesive oils and other similar substances can be used in many industries, and will save the laborious processes by which this class of work is generally accomplished.

THE PACIFIC METER COMPANY.

WE should like to call attention to the advertisement of the Pacific Meter Company which appears in another column. It is also desirable that buyers of gas meters on this coast should thoroughly understand some facts.

Every gas meter sold on the Pacific Coast is hauled from the Eastern seaboard states, a distance of about 3500 miles. On the way the meters, no matter how well packed they may be, are considerably shaken up and, as a result, some of them may run as much as 5 per cent. or much more, slow. Fifty or 60 per cent. of some lots of meters have been too slow to be put in use. Such meters may be 3, 5 or even 10 per cent. slow, and these percentages represent what the gas company would lose on every monthly bill. These figures clearly show how greatly important it is for every meter to be absolutely correct.

The Pacific Meter Company keeps in stock all those makes of meters, both plain and prepayment, which are everywhere recognized as standard and have been longest and most favorably known to the gas meter trade; and not only that, but every meter which this company ships from here is guaranteed to be absolutely correct.

The company can do this because it maintains a repair shop just for the purpose of making meters, however incorrect they may be, correct. This means, of course, a very considerable expense, for meters have to be rehandled here, unpacked, repacked, thoroughly tested, and, if incorrect or injured in any way, must be put in best possible condition, so that even if you test meters, the expense of proving them and putting them in perfect condition is thus saved. Certainly every intelligent gas man must realize the necessity of testing and going over thoroughly here all meters before they are shipped. All other sellers of meters on this coast ship them in cases just as they have come across the continent and without testing or going over them at all here.

The Pacific Meter Company repairs meters, but it could not maintain its repair shop on the repair work it gets. Moreover, if the company did not maintain its present repair shop, every gas company on the Pacific Coast would have to do its own repairing. This company is also the only business concern on the coast which carries a full stock of all necessary repair parts.

While the Pacific Meter Company sells all the principal makes of meters, it keeps in stock a meter under its own badge which, combining all the best features of the principal makes, is as nearly perfect as a meter can be made. It should also be clearly understood that these meters are sold at a discount as low as a meter can be figured after testing and going over them thoroughly here.

When this company began business about three years and a half ago, gas meters were and had always been delivered to the buyer on this coast just as they came from the Eastern factory. They were not tested or mechanically handled in a factory here at all in order to put them in perfectly fit condition before shipment by the agents here.

In this, as in all other important features of the gas meter business, the Pacific Meter Company has revolutionized the methods of selling gas meters, and is to-day the only seller of meters on the Pacific Slope which handles them according to that practice which is everywhere in the industrial world considered now to be absolutely essential.

A HAND PUMP FOR GRAPHITE LUBRICATION.

THERE are many engineers and others who, while recognizing the value of flake graphite in cylinder lubrication, have no lubricators which will handle graphite and are either unwilling to go to the expense of making the necessary changes, or believe that the occasional application of graphite suffices to give them a large measure of its benefits.

Many of these have hand pumps connected to their steam pipes or steam chests and inject a mixture of graphite and cylinder oil at stated intervals, or whenever the engines seem to need it, to supplement the regular oil supply. The pattern of hand pump shown in the cut has given the Joseph Dixon Crucible Company such satisfactory results in its own power plant that it has undertaken to supply the pumps direct as a matter of convenience to its customers. These pumps are made in two sizes, the larger adapted to steam engines, the smaller especially designed for automobiles and small motors. The price is $3.50 and includes pump and globe valve.

The mechanical pump offers the most satisfactory means of delivering a closely regulated supply of graphite and oil to engine cylinders, and as there are several makes that will satisfactorily perform this service, the Dixon Company will gladly furnish those interested with such facts regarding different pumps as it has found from its own trials, or will be pleased to refer any who may inquire to the different manufacturers of such lubricators.

THE CALIFORNIA ENGINEERING AND CONSTRUCTION COMPANY.

A FORMAL organization of the California Engineering and Construction Company has been effected and the following elected officers: C. P. Grimwood, president; Laurance I. Scott, vice-president; Henry F. Dutton, secretary; and P. F. Schneider, treasurer. The company has heretofore existed as a limited partnership, but the increase in business has been so rapid that it was found expedient to incorporate the company. Capital stock $100,000. The company engages as a general contractor in the design, construction and equipment of industrial plants, making a specialty of complete gas works and power plants.

The company has established a machine and pattern shop in the three story building at 63-67 Minna street, San Francisco, which has been equipped with the latest improved tools for the manufacture of special machinery and for repair work.

Including in the contracts being carried out by the company is a 100,000 foot crude oil gas plant at Ventura, Cal., for the Ventura Light and Power Company. A high pressure system is being installed, and the Johnson and Reynolds gas governors used. Work is progressing on the combined air lift and triplex, steam, pumping plant for the Bay Shore Water Company, in the Reese tract.

The company is Pacific coast agent for the Reeves Engine Company, Tabor Pump Company, Hall Steam Pump Company, William S. Heins, Franklin Boiler Works Company, and the United Flexible Metalic Tubing Company.

IMPORTANT CENTRAL STATION CONTRACT IN SAN FRANCISCO.

THE Crocker-Wheeler Company, through their Pacific Coast managers, the Abner Doble Company, of San Francisco, has secured a contract from the California Gas and Electric Corporation for three 4000-kilowatt, twenty-five-cycle, three-phase, 13,200-volt Crocker-Wheeler type alternators. These machines will furnish current to operate the United Railroads of San Francisco, in accordance with a contract recently secured by the California Gas and Electric Corporation. They will be direct connected to three 4000 horsepower Snow gas engines. The generators are to be of the revolving field type of machine, recently brought out by the Crocker-Wheeler Company, and the securing of the contract indicates that the important position this company has held in the direct-current field is also to be maintained in the alternating line. The generators are to operate at eighty-eight revolutions. . The installation of these three engine-driven generating units in San Francisco will mark an important step for the transmission company, as they will operate in parallel with the water power plants of the company, and thus serve as an important reserve plant for the entire system. One of the units will be used exclusively for handling the peak load on the railway lines.

SUBMARINE ILLUMINATION AT THE PORTLAND EXPOSITION.

ELABORATE submarine illumination of Guild's Lake will form a uniqe feature of the Lewis and Clark Centennial Exposition to be held at Portland, Or., beginning in June next. Guild's Lake, which is the largest body of water ever enclosed within an exposition fence, separates the mainland and the Government peninsula, and is spanned by the Bridge of Nations and the Trail, which are aggregately 2000 feet long. Chief Engineer J. R. Thompson has planned to place rows of fifty candle-power incandescent lamps on the bottom of the lake on each side of the Bridge of Nations. The lights will be enclosed in air and water tight marine receptacles, and when the illumination is accomplished it wiil be possible for spectators on the bridge to look down and see fish swimming in the lake.

In order to make the effect as attractive as possible, the lake will be filled with fresh water fish of various kinds, such as lake trout, catfish, bass, mullets and sunfish. Water plants will also be placed on both side of the bridge. To complete the picture, the surface of the lake will be dotted with Indian canoes, propelled by representatives of the Indian tribes through whose country Lewis and Clark passed in their historic pilgrimage a century ago. Besides these there will be a myriad of other craft, ranging from rowboats to racing launches of the latest pattern.

YOUTHFUL INVENTORS.

A dispatch from Boston says that two fifteen-year-old boys of that city have established a wireless telegraphic connection between their homes, half a mile apart. This recalls the fact that thirty days after the appearance of the first published accounts of Bell's invention of the telephone, two New York boys had built and were successfully operating an experimental telephone system of their own. These two boys have since achieved distinction in the electrical field, and have for many years been allied in business. They are Prof. Frank B. Crocker, of Columbia University, and Doctor Schuyler Skaats Wheeler.

TRANSPORTATION.

SUISUN, CAL.—J. W. Hartzell has secured an electric railway franchise to extend from Fairfield to Rio Vista and from Cordelia to Benicia.

MODESTO, CAL.—B. H. Kinney has applied for an electric railway franchise to extend along the public highways from Modesto to Oakland.

ALBUQUERQUE, N. M.—The Albuquerque Traction Company is to extend its line to the American Lumber Company's plant and to Highlands.

SAN DIEGO, CAL.—The San Diego Electric Railway Company is extending its line to Mt. Hope Cemetery, whence it will be continued to the old town.

RENO, NEV.—The electric railway line between this city and Sparks was placed in operation on November 23d, this being the first electric car line in Nevada.

VENTURA, CAL.—W. H. Burson, promoter of the Ventura-Bakersfield Electric Railway, conveys the assurance that active construction will begin at an early date.

VISALIA, CAL.—The Visalia Electric Railway Company will at once begin grading the roadbed for its line between Exeter and Lime Kiln, a distance of fourteen miles.

COLUSA, CAL.—W. F. Foreman, J. N. Miller, and T. H. Sullinger have applied for a franchise for the operation of an electric road over the highways of Colusa County.

SAN RAFAEL, CAL.—The Petaluma, Sebastopol and Santa Rosa electric road will be extended at an early date to Point San Pedro, where bay steamer connection will be made with San Francisco.

LOGAN, UTAH.—Local citizens have subscribed $8000 of the $25,000 subsiby necessary for the construction of an electric railway in this city. David Eccles, of Omaha, is behind the enterprise.

POINT RICHMOND, CAL.—The East Shore and Suburban Railway Company is staking its line between this city and Oakland, where it will connect with the tracks of the Oakland Transit Consolidated.

WALLULA, WASH.—J. V. Lewis is authority for the statement that there is contemplated the construction of an electric railway from the Homily Rapids to the Horse Heaven section, a distance of forty miles.

MARYSVILLE, CAL.—Plans are under negotiation for the extension of the tracks of the Marysville and Yuba City street car system into the mining districts, and if this is done the line will be made into a broad gauge electric road.

BAKER CITY, OR.—Isador Fuchs, who holds a franchise for an electric street car line in this city, proposes to extend the road from the Oregon Railway and Navigation depot to the Natatorium, a distance of one and one-half miles, and possibly to Haines, a distance of fourteen miles.

SACRAMENTO, CAL.—Clinton L. White, representing Sparrow, Smith and others, has applied for an electric railway franchise covering certain roads in the county and extending to the Amador County line at a point between Michigan Bar and Carbondale, ultimately reaching Jackson, Sutter Creek and Amador City.

SEATTLE, WASH.—The Edmonds Electric Light and Transportation Company will tap the surrounding timber belts with a network of electric railway lines, the first section of which will be finished for operation by May 1st, next. Ultimately this project will open up all the timber country east of Edmonds to a distance of forty-five miles.

SPOKANE, WASH.—C. A. Lunceford, of Davenport, president of the Adams County Electric Transit Company, which is building a dam at the Narrows which, together with the power plant, will cost $540,000, states that he has negotiated the sale of the first issue of $300,000 in bonds from the proceeds of which the Adams

County electric line will be built, and that partial arrangements have been made for floating a second issue of bonds amounting to $500,000 for extending the Adams County line into an interurban road that will have a length of 213 miles.

SAN JOSE, CAL.—J. F. Parkinson, of Palo Alto, and associates, have consumated the purchase of the San Jose and Santa Clara Railroad, with its Alum Rock and Tenth Street branches, the price being $1,000,000. Mr. Parkinson states that the company which be organized will at once begin the construction of a standard gauge electric line from San Mateo to Redwood City, to Palo Alto, to Mayfield and thence to San Jose by way of Mountain View, Sunnyvale and Santa Clara, and that from San Jose the line will be continued south to Gilroy. Franchises covering these routes are pending.

SANTA ROSA, CAL.—Regular hourly service on the new Westinghouse single-phase alternating current electric road, known as the Petaluma and Santa Rosa Railway, and which is the first electric line to be built and operated in Sonoma County, was begun on November 19th. Trains leave terminal points at 6 a. m., continuing hourly throughout the day until midnight, and making stops for freight and passengers at numerous stations. At the same time similar service was inaugurated on the Green Valley branch, extending from Sebastopol to Green Valley. It is stated on the authority of G. H. Rhodes, of Ukiah, that it is the intention to extend the Petaluma and Santa Rosa system to Cloverdale, then into Ukiah, with a branch continuing thence into Lake County.

SAN FRANCISCO, CAL.—By a contract signed on November 26th, between the California Gas and Electric Corporation and the The United Railroads, the former will, on January 1, 1906, furnish and deliver to the latter sufficient electric power for all its purposes, thus permitting the complete shutting down of the present steam power plants of the railway company except for auxiliary purposes. The power for the execution of this contract will be taken from the Bay Counties system and from the 15,000 horsepower gas engine and plant to be erected here, as previously descrtbed.* The power necessary for the operation of the system in that section of the city lying north of Market Street and between the bay and ocean and including the park and ocean line south of Golden Gate Park will be delivered to and distributed from the Turk and Fillmore Street substation: that used in operating the north end of the San Mateo line and Ingleside line and the northern end of the Mission Street line will be handled from the Geneva Avenue substation; that for the San Mateo line south will be from tha Milbrae substation, and the present power house at Bryant and Alameda streets will be converted into a substation whence will be operated the remainder of the system.

SAN JOSE, CAL.—The sale of the San Jose and Santa Clara Railway to J. C. Parkinson and associates, recalls the fact that in February of 1868 Samuel A. Bishop, with others, obtained a franchise to construct the San Jose and Santa Clara horse railway, and the work on the road was started in August of the same year. On the first day of November cars were running between the two cities, and the road was operated by horse power for a number of years. The first attempts to change the road to an electric line were made under the direction of an engineer from Detroit, who installed an underground trolley at a great expense- The system was not a success and the heavy outlay which it had necessitated proved almost disastrous to the line.

Not long after this the road came into the possession of J. H. Henry, J. P. Burke and other capitalists, who made a number of extensions and installed the overhead trolley system which is still in use. In the meantime a franchise for a road from the terminus of the San Jose and Santa Clara line at East San Jose to the city reservation at Alum Rock was secured by R. C. Quincey, and the Alum Rock line was built into the canyon. For many years this line was operated by steam, but it proved an unprofitable venture for the original promoters. The road finally passed into the possession of Hugh and George L. Center, who, a few years ago, also obtained control of the San Jose and Santa Clara line. Under the new ownership the two roads were consolidated, the Alum Rock road was equipped with an overhead trolley system, and many improvements were installed. With the growth of San Jose the railroad has proved a profitable investment, and is now looked upon as one of the best properties of its kind in the State.

*THE JOURNAL, Volume XIV, page 495, December, 1905.

TRANSMISSION.

AMERICAN FORK, UTAH.—The Utah Light and Power Company will install a new auxiliarry power plant to cost $150,000 in American Fork Canyon.

BAKER CITY, OR.—The Baker City Gas and Electric Company has established a substation at the Elkhorn Mine which is to be operated by electric power.

CITY OF MEXICO, MEX.—Ernesto Brunel has been granted an important water right on the Angulo or Zacapu River, State of Michocan, for power transmission purposes.

PENDLETON, OR.—Geary Kimbrell is making the preliminary surveys for the proposed power plant of the Umatilla Electric Power Company on the upper Umatilla River.

MARTINEZ, ARIZ.—The White Gold Mining Company, operating in the Black Rock district, will install an electric power plant for operating the new twenty-stamp mill that it is building

REDDING, CAL.—The Northern California Power Company is extending its transmission line from Balakalala to Kennet and thence to the site of the new smelters of the Mammoth Mining Company where a minimum of 700 horsepower will be used.

SANTA FE, N. M.—Joseph C. Bonner, president of the Toledo, O., stock exchange, contemplates the erection of a power plant on the Pecos River, twelve miles from this city, for the purpose of supplying Santa Fe, Los Vegas and Albuquerque with electric power and light.

LOS ANGELES, CAL.—The Edison Electric Company will deliver water-power to Los Angeles within a few days; having connected its lines by steel poles with that of the old United Gas and Power Company coast line. A 1200-kilowatt transformer plant is being built at Inglewood.

CITY OF MEXICO, MEX.—The Westinghouse Electric and Manufacturing Company, through their agents, Messrs. G. and O. Braniff & Co., of this city, has been awarded the contract for all the electrical apparatus to be installed at the El Oro Mining and Railway Company, El Oro, Mex. This contract amounts to nearly $100,000.

MANILA, P. I.—The Manila Electric Railway and Light Company, through J. W. Beardsley, its constructing engineer, has been making an examination of the Majayjay Falls, near Magsanjan, Laguna Province, for the purpose of inspecting the Caliraya River with the view of its utilization as the site of a power plant for a transmission line to this city.

OXNARD, CAL.—The Oxnard Light and Power Company have awarded the contract for its engines and boilers, consisting of 300 horsepower to Henshaw, Buckley & Co., of San Francisce. The contract for a forty-five or sixty kilowatt generator has not as yet been awarded. The plant of the company is being removed from the beet sugar factory to a operate building in the city of Oxnard.

GOLDFIELD, NEV.—Power Locations have been made on Bishop Creek, Inyo County, Cal., for a plant to have initial generating capacity of 3000 horsepower for transmission to Goldfield. It is believed that the project will be carried out without delay, for the enterprise is backed by men of the best financial standing, among whom are Rodney Curtis, who was for eighteen years president of the Denver Tramway Company, as well as its organizer; Frank J. Campbell, manager of the Vindicator Mine, o

Cripple Creek; C. M. Hobbs, for twenty-five years purchasing agent for the Denver and Rio Grande Railroad; L. B. Curtis, chief engineer of the work now proposed, and C. F. Potter. It is estimated that the work will cost about $300,000.

WALLA WALLA, WASH.—Eastern Washington and Oregon and a part of western Idaho is about to witness the completion of the transmission plant of the Washington and Oregon Power Company, the generating station for which is located on the South Fork of the Walla Walla River, about fifteen miles from the city of that name. Among the cities that are to be supplied therefrom are Walla Walla, Pendletou, Athena and Weston. Water for the operation of the plant is diverted from the river named and carried for a distance of five and one-quarter miles, constituting the water way, in a wood stave pipe constructed of 2x6 yellow fir taken from trees that were grown near Olympia, Wash., and Albany, Or. In round numbers 1,000,000 feet of lumber were required to build the pipe and about 600,000 feet of lumber to construct the trestles and foundations along the line. From the river the water is conveyed in a wood stave pipe running along the easterly bank of the Walla Walla River and crossing six canyons, the deepest of which is 170 feet from the grade line, while in places cuts are made through solid rock to a depth varying from fifty to seventy-five feet. Inverted siphons are used in crossing canyons. The pipe line is forty-eight inches in diameter and in its construction 400,000 pounds of steel bands were used, the separation between these bands varying from one foot under light heads to approximately one-quarter of an inch under heavy heads. The diversion of the water is made through a crib dam built of 10x10-inch timbers filled with broken rock. The pipe line has a gradient of three feet per 1000 feet of line, and carries eighty-five cubic feet of water per second. A reservoir cut out of the mountain side is located at the head of the power pipe line at a head of 360 feet above the power house. Normally the reservoir will carry water to a depth of fourteen feet, which will give it a capacity of 300,000 feet. From the penstock a forty-two-inch pressure pipe will deliver the water to Pelton water wheels which are specially made, in that each unit consists of five wheels mounted on a single shaft with two nozzles to a wheel. There are three such units, each of which drives a 500-kilowatt generator of the General Electric three-phase, 2300-volt, revolving field type. Twenty-three thousand volts is to be delivered to the transmission line, and the local distribution will be at 2080 volts, with ultimate distributions of nominally 110 volts. Samuel Storrow, of Los Angeles, is the consulting engineer of the Washington and Oregon Power Company; F. S. Badger, formerly in the employ of the Government at Tonto Basin, Ariz., is in charge of the construction as engineer, and N. Lawson is superintendent. The lower end of penstock was built of steel by the Risdon Iron Works, and the stave pipe and upper end of penstock by the National Wood Pipe Comyany, of Los Angeles, under the immediate superintendence of their engineer, J. L. Hammond.

FINANCIAL.

ORANGE, CAL.—The ordinance calling for a bond election to vote on municipal water and electric lighting plants has been passed.

SAN FRANCISCO, CAL.—On December 15th the California Gas and Electric Corporation paid dividend No. 8 of 25 cents per share on the issued capital stock of the company.

SANTA MONICA, CAL.—The Home Telegraph and Telephone Company, of this city and Ocean Park, and which is now constructing its system here, will hold a stockholders meeting on January 20th to create a bonded indebtedness of $150,000.

REDWOOD CITY, CAL.—The First National Bank of San Mateo County has taken the entire issue of $100,000 of municipal bonds lately voted for municipal improvements and water mains at par. The bonds bear 4½ per cent. interest and run forty years.

LOS ANGELES, CAL.—The American Trust and Savings Bank of Chicago is offering at par and interest a block of the first and refunding mortgage 5 per cent. gold bonds of The Edison Electric Company, of Los Angeles, due September 1, 1922, but subject to call on and after September 1, 1907, at 110 and interest. These bonds, of which $3,528,000 is outstanding and $477,000 in escrow to retire sub-company bonds, are part of an issue limited to $10,000,000; but the unissued bonds can be put out only for 75 per cent. of the cost of improvements and acquisitions, and then only when the net earnings are one and three-fourths times the interest charge on bonds issued and proposed. Capital stock outstanding: Common, $2,137,900; preferred, $3,530,200. For the year ended June 30, 1904, the gross earnings were $928,379; net, $429,944; interest charges, $184,119; balance, surplus, $245,825. The company is paying 5 per cent. per annum on its preferred stock and is earning net about two and one-half times its interest charge. The completion of the water power development on the Kern River will bring additional gross and net income, work on the first plant of which will be started January 1st, to be completed in one year, and to generate 24,000 horsepower. The company has five claims on water rights, and will later build four additional plants of about 24,000 horsepower each.

SAN FRANCISCO, CAL.—The comparative statement of the California Gas and Electric Corporation for the month of October show the following increases: Gross earnings, $134,122.66; expenses, $103,997.18; profit, $30,125.48; corporation bond interest, $3125; and net surplus, $27,000.48.

The official statement of earnings for October 1903 and 1904 is:

Gross earnings	$244,276.09	$378,401 75
Operation, maintenance, taxes, insurance and bond interest of subsidiary companies	179,625.44	283,622.52
Profit	$ 64,653.65	$ 94,779.13
Corporation bond interest	33,333.33	36,458.33
Balance	$ 31,320.32	$ 58,320.80
Sinking fund	12,500.00	12,500.00
Net surplus	$ 18,820.32	$ 45,820.80

For eight months to October 31, 1904, gross earnings increased $880,554.84; profits over cost of operation increased $177,395.60, and net surplus over all expenses and charges, including proportion of sinking fund, increased $146,681.39.

The comparative statement of earnings and expenses for the eight months to October 31st is as follows:

Gross earnings	$1,811,577.17	$2,692,132.03
Operation, maintenance, taxes, insurance and bond interest of subsidiary companies	1,312,114.60	2,015,273.80
Profit	$ 499,462 57	$ 676,858.17
Corporation bond interest	260,952.45	291,666.66
Balance	$ 238,510.12	$ 385,191.51
Sinking fund	100,000.00	100,000.00
Net surplus	$ 138,510.12	$ 285,191.51

NEW INCORPORATIONS.

PRESCOTT, ARIZ.—Gas Saving Manufacturing Company; capital stock, $500,000; incorporators, J. M. Tierney, George S. Lang, Andrew Thompson, and others.

LOS ANGELES, CAL.—Pacific Plating Company; capital stock, $25,000, of which $500 has been subscribed by W. E. Giles, R. W. Bailey, C. J. Wells, W. W. and E. Murray.

SACRAMENTO, CAL.—The Electrical Supply Company; capital stock, $10,000, of which C. V. Schneider holds all but $40. The company was formed to take over the business formerly owned by C. V. Schneider.

SANTA CRUZ, CAL.—The Automobile Battery Company; incorporated by A. J. Hinds, E. C. Lilly, Phillip Trapp, and others. Object to establish an automobile factory and repair shop and to manufacture storage batteries.

SEATTLE, WASH.—Current Power Company; capital stock, $2,000,000; incorporated by Edgar Courtwright, W. H. Boothroyd, and Guy C. Hamilton, of Tacoma, and J. D. Handberry, J. R. Carman and Phillip, of Seattle.

LE GRAND, OR.—Grande Ronde Electric Company, consisting of the consolidation of the La Grande Electric Light Company and the Cove Power Company; directors, Walter Pierce, J. A. Thronson, T. H. Crawford, Clarence Crawford, and T. R. Berry, of Union.

SAN FRANCISCO, CAL.—On November 28th A. M. Haines, James K. Burch, Franklin Bowring, and others, filed articles of incorporation of each of the four companies which follow: Lake County Light and Power Company, Clear Lake Securities Company, Lake County Laundry Company, and Lake County Ice Company, each having a capital stock of $25,000.

CHEHALIS, WASH.—The Washington Central Railway Company; capital stock, $500,000, divided into 10,000 shares of $50 each, by George E. Long, M. D. Sayles, and L. E. Crouch, of Portland, Or. The corporation will acquire, construct, build and operate a railway, telegraph and telephone line from a point on Grays Harbor, near Grays Harbor city, to the foot of Priest Rapids, Yakima County, Wash., and a five-mile branch line starting about five miles from Centralia.

TELEPHONE AND TELEGRAPH.

BEND, OR.—The Des Chutes Telephone Company is extending its telephone line from Bend to Laidlaw.

PORT TOWNSEND, WASH.—The Glendale Creamery Company is to extend its line from Gettysburg to Forks.

SANTA FE, N. M.—The Public Utilities Company is to build a telephone line between this city and Artesia at once.

SAN LUIS OBISPO, CAL.—S. D. Ballou has applied for a telephone franchise to cover the county roads of San Luis Obispo.

WILBUR, OR.—T. B. Seton is to construct a telephone line that will reach to Nespelen, covering all intermediate territory.

REDONDO, CAL.—The Home Telephone Company, of Los Angeles, has been granted a local fifty-year telephone franchise.

ONTARIO, CAL.—The Home Telephone Company, of Los Angeles, has made application for a telephone franchise for this city.

BISHOP, CAL.—H. H. Clark, of the Bullfrog Mining Company, is to erect a telephone line at once between Goldfield and Amatgosa.

FRESNO, CAL.—The Home Telephone and Telegraph Company is applying for a local franchise, and if it is granted the construction of a new system will be immediately begun.

OAKLAND, CAL.—The Pacific Wireless Telegraph Company, of which Eben Smith is president and Albert L. New is general manager, is installing its plant on Seventh and Alameda streets.

HILLSBORO, OR.—A farmers' telephone company, of which Louis Manning is president and William Ross is secretary, has been organizod at this place and will begin the construction of the plant immediately.

LOS ANGELES, CAL.—B. F. Kierulff, Jr., & Co., southwest agents for the Stromberg-Carlson telephones, have recently secured the adoption of their telephones by the Pasadena Home Telephone Company, and have also sold the complete equipment for the new Banning exchange, at Banning, Cal.

CLARKSTON, WASH.—Applications for telephone franchises are pending by the Clarkston Independent Telephone Company and the Pacific States Telegraph and Telephone Company, respectively, Greenville Holbrook representing the Clarkston company and D. J. McGilvroy representing the latter. It is probable that the franchise will be granted to the Clarkston people.

LITIGATION.

SAN FRANCISCO, CAL.—There is now pending in the United States Circuit Court for the District of California, three suits of great importance to the owners and prospective owners of buildings in this State. The suits are entitled "Otis Elevator Company vs. Burton C. Van Emon." The Otis Elevator Company claims that Van Emon is infringing upon patents owned by it in the construction of his elevators. Van Emon denied that he has ever infringed upon any patents, and filed his answer to that effect. Some time after he filed his answer he alleges that he came into possession of facts showing that the Otis Elevator Company had formed a secret and illegal trust with Cahill & Hall, A. D. McNicoll & Co., The Fraser Elevator Company, and the Electrical Engineering Company, and that when builders ask for bids for elevators to be put in their buildings all these companies put in separate bids just as if they were rivals and presenting *bona fide* bids against each other, when, in fact, all of the bids handed in are fixed beforehand by the Otis Elevator Company. In this way it is alleged a fraud is perpetrated upon the public. Upon the discovery of these facts Van Emon set them up in a plea and also the fact that the suits were brought to get the Circuit Court to aid the combination to sustain and perpetuate a monopoly which under the Sherman Anti-Trust Act is criminal. The plea asks that the suits be dismissed by the Court for the reason that the Court will not be used to help by injunction the commission of crimes. The Otis Elevator Company tried to defeat the filing of the plea, saying that notwithstanding there may be an illegal monopoly in doing what the plea says they are doing, they have a right to go on with their suits and have the Courts help them.

Judge Morrow decided to allow the plea to be filed and stated from the bench that he would give Van Emon thirty (30) days in which to take his evidence showing that such an illegal combination exists. The attorney for Van Emon argued that the Court instead of helping the Otis Elevator Company by giving the injunction asked for by it, ought to, after the evidence is taken, turn the Otis Elevator Company over to the United States District Attorney for prosecution as a criminal, and that the Courts were expected, under the Sherman Act, to suppress illegal trusts and not to aid them in maintaining themselves as criminals breaking down other people who are rivals to their criminal business.

Mr. Van Emon is ready to take the testimony under the plea allowed to be filed by Judge Morrow, and says that he will be able to prove the secret and criminal trust which he alleges exists.

John H. Miller appeared for the plaintiff and J. J. Burt for the defendant upon the motion to be allowed to file the plea.

ILLUMINATION.

FULTON; CAL.—A municipal electric light plant is under consideration.

PHILOMATH, OR.—A. B. Horning has secured an electric light franchise.

VISALIA, CAL.—William Ketner has secured a local electric lighting franchise which he states will be in operation by May 1, 1905.

NEEDLES, CAL.—The Murphy Water, Ice and Light Company will, it is reported, iustitute its electric lighting plant soon after New Years.

GOLDENDALE, WASH.—R. T. Robinson has secured a twenty-year electric light franchise, and states that the plant will be in operation by April 1st.

ARCATA, CAL.—Brousse Brizard, who, it is surmised, represents the North Mountain Power Company, has purchased the Arcata electric light plant for approximately $20,000.

NEWMAN, CAL.—The recently organized Newman Ice and Cold Storage Company, and which is allied to the Newman Electric Light Company, will have its new plant in operation before next summer.

ALBUQUERQUE, N. M.—The Albuquerque Electric Power and Lighting Company has purchased the electrical machinery of the Cochiti Gold Mining and Milling Company and is moving it to Albuquerque.

BALLARD, WASH.—Ernest V. Brower, who has made application for an electric light franchise, guarantees to have 2500 sixteen-candlepower lamps in operation within six months, provided the franchise be granted

ORANGE, CAL.—A special election is to be held on January 7th to vote upon municipal bonds, as follows: Fifty thousand dollars for water works, $15,000 for electric light and power plant, and $10,000 for a new city hall.

OCEANSIDE, CAL.—E. D. Griffes, of Los Angeles, having secured a local gas and electric franchise, has entered into a three-year contract for city street lighting. Mr. Griffes represents the Oceanside Gas and Electric Company.

GAS.

FULLERTON, CAL.—A gas franchise for this city is to be sold to the highest bidder on January 16th.

ORANGE, CAL.—M. L. Willits has secured a franchise for a complete gas works and distributing system.

MONROVIA, CAL.—F. O. Frazier, of the Redondo Gas Works, is investigating the advisability of building a gas works for this city.

OXNARD, CAL.—The Ventura Water, Light and Heat Company has secured a gas franchise and has practically finished its distributing system thereunder.

HONOLULU, T. H.—The Honolulu Iron Works has secured the contract for over fifteen miles of gas mains for extensions of the Honolulu Gas Company's system.

SEATTLE, WASH.—The Seattle Lighting Company is to lay approximately 100 miles of new gas mains, for which permits have been secured for the laying of thirty miles of mains.

VALLEJO, CAL.—The Vallejo Gas Light Company has been acquired by the California Gas and Electric Corporation, which, it is stated, will expend some $25,000 in local improvements.

LOS ANGELES, CAL.—It is announced by the local press that the Independent Gas Company, using the Lowe crude oil water gas spstem' has finally determined to complete its plant at an early date.

ALBUQUERQUE, N. M.—J. A. Jones, of Chicago, and F. H. Kent, of this city, have applied for a gas franchise, agreeing to lay ten ten miles of mains and to begin the construction of the works within sixty days.

NORTH YAKIMA, WASH.—J. J. Chambers, representing Seattle capital, has secured a gas franchise under which it is proposed to builn a plant that will cost over $100,000. Work thereon must be commenced within six months, and the plant must be finished by September, 1906.

SAN BERNARDINO, CAL.—A new gas plant having a capacity of 100,000 cubic feet per day is to be established here by a new company that is to be incorporated primarily by J. B. Shepardson, of Colton. Its capital is to be $100,000, and Seth Hartley is authority for the statement that the contract for the gas making machinery has been let to Barlh & McGillivray, of Corona, and that the Crane Company, of Los Angeles, has secured the contract for the pipe.

TULARE, CAL.—William Ketner, of Visalia, has secured a franchise for the laying of gas mains in this city, and will distribute gas that is to be received from Visalia through a high pressure gas transmission line. Those associated with Mr. Ketner are Clarence L. Smith, af San Francisco, and B. S. Pederson, of the San Francisco office of the Western Gas Construction Company. It is expected that the plant will be in operation in both Visalia and Tulare by May 1, 1905.

LOS ANGELES, CAL.—On November 30th the Los Angeles Gas and Electric Company announced that from January 1, 1905, it will furnish gas at the rate of 90 cents a thousand, a reduction of 5 cents a thousand from the present price. In 1889 the price of gas in Los Angeles was $2.25 a thousand. In the following year the price was reduced to $2.00, in 1895 to $1.90, in 1896 to $1.75, in 1898 to $1.65, in 1900 to $1.60, and again in the same year to $1.50; in 1901 to $1.25, in 1902 to $1, and in 1903 to 95 cents.

LOS ANGELES, CAL.—The Los Angeles Gas and Electric Company has decided to discontinue its gas appliance department, and is turning its business over to the dealers. Mr. W. B. Cline, president of the company, states that the department was organized to educate the people in the use of gas. Having accomplished this purpose the stock is being sold out. C. F. Stanyss, formerly solicitor for the company, has rented a storeroom adjoining the company's office in South Hill Street, where he will carry a full line of appliances. The Beacon Light Company, and the Nauerth Hardware Company is also engaged in the sale of gas appliances.

OIL.

MONTEREY, CAL.—The Coalinga Oil and Transportation Company is to erect an oil refinery at Seaside, a new town on the bay shore about six miles north of this place.

VENTURA, CAL.—The pipe line of the Ventura Natural Gas Company has been finished between this city and Oxnard, and by January 1st the local distributing system will have been finished.

LOS ANGELES, CAL.—The Chicago Crude Oil and Fuel Company, a local concern of which Norman F. Marsh is president, is drilling a well under the direction of Dr. D. S. Green at Roland Station, on the Salt Lake line.

COALINGA, CAL.—Dr. Alexander Dallos, of Bayonne, N. J., is here engaged in the preliminary work of a project for building another eight-inch pipe line from this place to the coast. The enterprise is backed by Eastern capitalists, who have incorporated it as the Producers' Union Pipe Line Company.

WATER WORKS.

SAN DIEGO, CAL.—Engineer C. S. Alverson is locating the site for the proposed pumping plant for San Diego in El Cajon Valley. The city will advertise for bids for water and sewer pipes in a few days.

MISCELLANEOUS.

An Otis electric elevator has been shipped from Yonkers, New York, to the Grand Cathedral at Berlin for the exclusive use of the German Emperor.

The Cuymaca Mining Company of San Diego County, of which G. H. Clark is general mananger is in the market for a 500-light machine, wiring, etc.

The Brode Electric Company has bought the business and equipment of the Benset-Call Electric Company, 426 West Seventh Street, where the company will maintain a branch store.

The Woodill Hulse Company of Los Angeles, is preparing to go into the manufacture of switchboards and panels. The Company's plant on South Los Angeles Street, will be used for this purpose.

The transfer of the plant and business of the Los Angeles Electrical Specialty Company to Messrs. Emmons & Hughson of the Ecco Battery Company, of San Francisco, will be effected January 1, 1905.

The contract for a 240-kilawatt engine type generator was awarded by the city of Alameda to the Kilbourne & Clark Company. The National Electric Company will build the generator. The contract for the engine was awarded C. C. Moore & Co., who will install a Harrisburg corliss.